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THE FLORIDA MARSH RABBIT

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The habits, life history and local distribution of the Florida marsh rabbit, *Sylvilagus palustris paludicola*, were studied from October 1, 1934, to April 21, 1935. Most of the work was done in the vicinity of Gainesville, Florida, but I have included some observations made in Dade County, in the Everglades, and also in Gadsden County in western Florida.

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Melanism.—A totally black marsh rabbit was shown to A. F. Carr at Englewood, Florida, by a negro who had shot it. Residents at Cape Sable said that black marsh rabbits occasionally are found in that region.

Daily Rhythm.—The marsh rabbit usually spends the day sitting in a form that is well-hidden, often in the midst of a brier patch, but I observed one exception to this rule. Two marsh rabbits, one evidently in pursuit of the other, were seen at Rifle Range Pond at 3 P.M. on March 8. About an hour before dark the rabbits become active. On several occasions at Newnan's Lake they have been seen hopping about at dusk. Two were seen in a hammock at Cape Sable about 30 minutes before dark. It seems, however, that the marsh rabbit is most active at night. They have been observed with the aid of a headlight at almost all hours of the night, from 8 P.M. to 4 A.M. Captive rabbits normally eat only during the night. They may be forced to eat during the day by with-holding food for one or two nights and then introducing food into the cage during the day. Caged rabbits, after having become accustomed to captivity, spend the greater part of the day sitting quietly in the boxes or hollow logs provided for them.

Methods of Escape.—As is the case with most rabbits, the marsh rabbit seeks to escape

detection by an approaching enemy by crouching in its form. One may approach to within a few feet of a form, or actually walk by the crouching rabbit, without causing it to move. Its dark colors blend so well with the shadows of dense hammocks and thickets that the rabbit seldom is seen until after it moves. If forced to run the animal does not escape by a burst of speed as does the cottontail, but hops slowly and deliberately away for 20 or 30 feet and then stops. If disturbed further it hops a short distance farther and stops again.

Audubon and Bachman (1846, p. 154) implied that the marsh rabbit seeks escape by swimming in preference to escape on land. My observations have shown, as have those of Coues (1869, p. 87), that in spite of its aquatic adaptations, this animal is much more at home on land than in water. I never have seen one enter the water voluntarily, and doubt very much that they do so as a means of escape except when hard pressed, and when no other avenue of escape is available. A marsh rabbit could not be driven into the water at Rifle Range Pond. It was cut off from a brier patch and driven to the edge of the water. Rather than enter the water it ran along the edge of the pond for about 15 feet and dodged back toward safety in the briers.

Swimming.—A captive marsh rabbit was released in Newnan's Lake about 200 yards from land. When its cage was opened the rabbit darted out and dived from the boat. It started swimming in a diagonal direction toward the nearest shore. For a time the rabbit outdistanced the boat, a clumsy craft, but after the first 100 feet it began to tire and easily was overtaken. While swimming fast the rabbit did not follow a straight line but swerved first to the right and then to the left, and the whole body undulated from the effort. After slowing down it swam in a much straighter line. While swimming, only the head and a small patch of rump were exposed. When about half way to land the animal ceased swimming and floated for several minutes. It then allowed itself to be lifted into the boat, but immediately it again plunged into the lake and swam toward shore. When the boat was pulled in front of the rabbit, it ceased swimming and floated as though dead. When poked with the paddle it swam to the shore, where it pulled itself from the water and rested extended on the water hyacinths.

Bathing.—During the night the water almost invariably was splashed from the pan placed in the rabbit's cage. At times all of the water was gone, and on other occasions various amounts remained in the pans. The water generally was tracked all over the cage floor and the top of the rabbit's hollow log. This trait was common to all of the 9 rabbits kept caged and supplied with large pans of water. These findings correspond to some extent with the observations of Audubon and Bachman (1846, p. 155). There seems to be some correlation between bathing and the humidity of the air. On foggy or rainy nights there was little or no water splashed from the rabbits' pans.

Fighting.—Captive marsh rabbits show the same tendency to fight as noted by Dice (1929, p. 226) in the case of the cottontail. They defend themselves either by slapping or boxing with their front paws, or by biting. Of the two, biting seems to be the more effective method of offense. Two males, one of which was considerably larger than the other, were allowed to remain overnight in a small box. The next morning the smaller male was found to have a small hole bitten through one ear, and on the back were numerous bare spots, which lacked skin as well as hair. There also was a quantity of fur on the floor of the box.

These two males were placed together in a cage on January 11 and remained there for 7 days. On the seventh day the smaller male died, and its skin was removed. The entire back, as well as the top of the head, was covered with tooth marks. There was hardly a spot on the dorsal surface that did not exhibit either a bruise or a laceration. Many of the wounds showed only as dark purple or reddish bruises, but a considerable number of them were cuts through the skin.

This hostility does not seem to be limited to members of the same sex. A male and a

female of equal size were placed in a cage on November 7. Whenever one approached the other, each reared on its hind legs and slapped at the other's head with its front paws. Occasionally one endeavored to bite the hind quarters of the other. They were left in the cage for one night. The next morning the male was bitten severely on the back and hind quarters, patches of skin being missing in several places, while the female showed no scars.

When being handled, marsh rabbits attempt to escape by kicking vigorously with the hind legs. If care be not taken to hold both legs firmly their frenzied efforts often produce painful scratches on hands and arms. Their wild kicks seem utterly uncontrolled, and often do more damage to the captive than to the captor. One rabbit, while being lifted from a box trap by the loose skin of its back, tore a mass of skin over an inch in diameter from the side of its neck as a result of its wild kicking. The underlying muscles also were lacerated and torn by the animal's claws.

Behavior in Captivity.—Marsh rabbits were kept in a normal habitat at Newnan's Lake. Each cage was provided with a hollow log or box into which the captive could retreat. None of them grew tame or became reconciled to human presence. When placed in the cage each individual almost invariably dashed into the surrounding hardware cloth, and this was continued for several minutes in spite of the bloody nose that usually resulted. The rabbits seemed to be controlled entirely by a fear instinct, and to forget everything but immediate escape. After some time they discovered the box or hollow log in the cage and dashed into it. After that most of them took refuge in the box or log at the approach of a person. An individual caged for 3 months seemed to become very well adjusted to its new home. It spent every day in the hollow log and moved about only at night.

Voice.—The cry of the marsh rabbit was heard on numerous occasions. It not only squeals when caught, but also utters a cry when entirely free and unharmed. About one-fourth of the rabbits captured in live traps emitted shrill cries when taken from the traps and handled, the squeals often lasting for 2 or 3 minutes. After being silent for a moment the rabbit sometimes squealed again, or even a third time. Wounded rabbits were heard to emit a similar cry, and an individual released from captivity uttered a series of sharp cries as it hopped away. A specimen of *Sylvilagus palustris palustris*, startled from its form near Quincy, Florida, gave a short squeak before running away. John M. Kilby stated that in his experience the marsh rabbit often squeaks before running away, but that the cottontail never does so.

A marsh rabbit was seen in pursuit of another at Rifle Range Pond on March 8. The first animal hopped leisurely past A. F. Carr and myself without noticing us. The second rabbit became alarmed, turned at right angles to its course, and hopped away at a faster gait. As it did so it thumped the ground loudly with its hind feet, squealing sharply at each thump. Another marsh rabbit, flushed from a patch of broom-sedge in the same region several days later, repeated the thumping and squealing performance as it scampered away.

Senses.—The marsh rabbit readily sees movements, but seems to have little perception of form or detail. A caged rabbit sometimes emerges from its box and moves about apparently unconscious of an observer as long as the person remains immovable. Even a slight movement, however, will frighten the rabbit and cause it to return to its box.

The hearing of the marsh rabbit is very keen. A caged animal is startled by a slight rustling of nearby leaves even though one remains hidden from its sight.

Taste probably is used a great deal in the selection of food. Even foods not favored by captive rabbits almost always were slightly nibbled.

Intelligence.—After two or three days of captivity most of the rabbits took refuge in their boxes or hollow logs at the approach of a person. One rabbit consistently refused to retire at my approach, but dashed wildly around the cage. After 12 days of skinning

its nose on the wire the rabbit learned to dash about without striking the sides of the cage. At my approach, it then ran from one end of the enclosure to the other, stopping and turning when within about one foot of the wire. This procedure was continued for a minute or two, with the rabbit always turning at the same place. It sometimes ran near the wire, but never into it. At other times the animal ran at full speed around its box in the same way for two or three minutes. Then it retreated into the box.

Scatology.—The droppings of the marsh rabbit are not distinguishable from those of the cottontail. Most pellets are gray when dry, but some are brown, and a few are black or reddish in color, probably depending upon the food eaten. Thirty-four dry marsh rabbit pellets were weighed and measured. The average length was 9, and the average width 8 mm. The average weight was 1.2 milligrams.

In hammocks the pellets generally are placed on logs or stumps. Sometimes they are grouped in one relatively small spot, but they may be scattered from one end of a log to the other. At times they are scattered at random in brier tangles and on the ground of a hammock. In grassy areas and marshy places, or at the edges of ponds, the droppings usually are deposited in piles containing from 40 to 100 or more pellets. These piles most often are located in the beaten paths of the marsh rabbits. Scattered pellets, however, are found in the mud of pond borders, along the runways, or even on floating vegetation.

Caged marsh rabbits have a tendency to drop most of their feces in a particular spot. In this way a pile of several hundred pellets accumulates within a few days. Captive rabbits also deposit pellets on the tops of logs and nest boxes. Some pellets seemingly are dropped indiscriminately about the floor of the cage. Some feces usually are discharged while the animals are eating. This habit may account in part for the finding of large piles of pellets in some places, but it cannot explain the occurrence of pellets on logs and stumps where no food is available. For lack of more knowledge of motivating influences one may assign to this species, as to the cottontail, the instinct that Seton (1920, p. 68) has termed sanitation.

Breeding Habits.—There seems to be a rather definite breeding season for the marsh rabbit, but there is insufficient evidence to define it with accuracy. A probable mating ceremony was observed at Rifle Range Pond on March 8, when one rabbit was seen pursuing another at a leisurely pace. No pregnant individuals were found among the 17 females taken between October 23, 1934, and March 16, 1935, but the uterus of a female secured on March 21 contained 5 swellings. A female shot on April 22 had 4 embryos that measured 32 mm. in length. The uterus of a marsh rabbit shot on May 30, 1928, by H. B. Sherman, showed 3 swellings 13 mm. in length. Dr. Sherman found 4 embryos that measured 37 mm. in a female taken on March 23, 1929.

Foods Eaten in Captivity.—The caged rabbits were offered as food 64 different species of plants. Some were eaten readily, while others were consumed only when no other food was available, and some absolutely were refused. All of the plants except the cultivated ones were selected from the habitats in which marsh rabbits were found. As a rule, when a new plant was given the captives, another plant to which they were partial also was given, in order to check the palatability of the new food.

The leaves and twigs of 18 trees, shrubs and woody vines were eaten by the caged rabbits, as follows:

French mulberry (*Callicarpa americana*)
Dwarf thorn (*Crataegus uniflora*)
Blackberry (*Rubus betulifolius*)
Dewberry (*Rubus continentalis*)
Sweet gum (*Liquidambar styraciflua*)
Common elder (*Sambucus canadensis*)

Red bud (*Cercis canadensis*)
Ward's willow (*Salix longipes*)
Yellow jessamine (*Gelsemium sempervirens*)
Water oak (*Quercus nigra*)
Groundsel tree (*Baccharis halimifolia*)
Saw brier (*Smilax glauca*)
China brier (*Smilax bona-nox*)
Green brier (*Smilax rotundifolia*)
Wild bamboo (*Smilax auriculata*)
Jackson brier (*Smilax lanceolata*)
Sarsaparilla (*Smilax walteri*)
Sarsaparilla vine (*Smilax pumila*)

Plant names used are those employed by Small (1933).

This group of species represents a potential source of food for marsh rabbits during the winter months, as several of the species, such as the water oak, the two species of blackberries, and some of the species of *Smilax*, retain their leaves throughout the winter. Many seedlings grow within the reach of marsh rabbits, and leaves constantly are falling from the trees throughout the winter. The leaves of the green briers, especially, fall during most of the winter. The reference here is not to dead leaves but to green or partly-green leaves blown from the trees by wind or removed from them by other means.

The captive marsh rabbits readily ate 18 species of herbaceous plants, as follows:

Centella (*Centella repanda*)
Marsh pennywort (*Hydrocotyle umbellata*)
Marsh pennywort (*Hydrocotyle* sp.)
Cat-tail (*Typha latifolia*)
Rush (*Juncus effusus*)
Arrowhead (*Sagittaria lancifolia*)
Smartweed (*Persicaria hirsuta*)
Ground cherry (*Physalis floridana*)
Nightshade (*Solanum sisymbriifolium*)
Water hyacinth (*Piaropus crassipes*)
Ruellia (*Ruellia parviflora*)
Golden club (*Orontium aquaticum*)
Violet (*Viola esculenta*)
Yellow woodsorrel (*Xanthoxalis langloisii*)
Sow thistle (*Sonchus oleraceus*)
Golden fumeroot (*Capnoides aereum*)
Cinnamon fern (*Osmunda cinnamomea*)
Bracken (*Pteridium aquilinum*)
Chain fern (*Woodwardia areolata*)

In this group of plants occur several species that probably comprise a major portion of the food of the marsh rabbit. *Centella repanda*, a low, semi-aquatic herb, proved to be one of the favorite foods of captive rabbits. This plant is available in great abundance in all of the habitats in which marsh rabbits have been found during this study. The marsh pennywort also is well liked and abundant in marsh rabbit habitats. The cat tail and the rush are liked very much and are probably heavily grazed wherever they are found. Water hyacinths offer a year-round source of food, but they are not as well liked as some of the other plants.

The captives were fond of the seeds and fruits of several species of plants, as follows:

French mulberry (*Callicarpa americana*)
Magnolia (*Magnolia grandiflora*)
Tupelo (*Nyssa sylvatica*)
Dwarf thorn (*Crataegus uniflora*)
Gallberry (*Ilex glabra*)
Chokeberry (*Aronia arbutifolia*)
Saw palmetto (*Serenoa serrulata*)
Nightshade (*Solanum sisymbriifolium*)
Saw brier (*Smilax glauca*)

This group of foods probably forms an important addition to the diet of the marsh rabbit during the fall and winter. The pungent, red seeds of the magnolia, avidly eaten by caged rabbits, probably are sought in the wild during the fall months. The fruits of the French mulberry and the dwarf thorn also are available to rabbits. The black drupes of the tupelo are to be found on the ground in the fall. The fruits of the gallberry and chokeberry also are available during fall and winter.

Captive marsh rabbits ate 4 species of vegetables that were offered to them, as follows:

Sweet potato (*Ipomoea batatas*)
Carrot (*Daucus carota*)
Turnip (*Brassica* sp.)
Onion (*Allium* sp.)

The leaves of 6 species of plants were eaten by the captives when no other food was allowed them. These plants were as follows:

Saw palmetto (*Serenoa serrulata*)
Lizard's tail (*Saururus cernuus*)
Hackberry (*Celtis mississippiensis*)
Cabbage palm (*Sabal palmetto*)
Water starwort (*Callitriche peploides*)
Mushroom (*Polyporus* sp.)

When these species were placed in the cages with foods that the rabbits liked, they were rejected. They were forced upon the rabbits, and could hardly be considered a normal part of their diet. The fact remains, however, that in case of a shortage of the regular foods these plants could and undoubtedly would be utilized.

The leaves of 15 of the plants offered to the captive rabbits absolutely were refused. These comprised the following:

Papaw (*Asimina triloba*)
Wild plum (*Prunus americana*)
Poison ivy (*Toxicodendron radicans*)
Persimmon (*Diospyros virginiana*)
Magnolia (*Magnolia grandiflora*)
Holly (*Ilex opaca*)
Bullace grape (*Muscadinia munsoniana*)
Red mulberry (*Morus rubra*)
Wax myrtle (*Cerothamnus ceriferus*)
Gallberry (*Ilex glabra*)
Deer tongue (*Trilisa odoratissima*)
Spanish moss (*Dendropogon usneoides*)

Bonnets (*Pistia stratiotes*)
Pokeweed (*Phytolacca americana*)
Green brier (*Smilax laurifolia*)

Most of the plants refused were nibbled to some extent, except for the rejection of the leaves of holly, magnolia, and poison ivy. The leaves of the gallberry were refused, while the berries were eaten.

Foods Eaten in Nature.—Experiments with captive rabbits have shown that the species is not highly selective in its food preferences. In nature a great variety of foods undoubtedly is eaten, and these are present in abundance throughout the year. Records of foods chosen in nature are difficult to procure because of the great abundance of potential food in the habitats in which the marsh rabbits are found, and also because of the difficulty of observation. The quantity of vegetation consumed by a population of marsh rabbits is so small in comparison with the remaining plants that it is scarcely noticeable.

On January 5, there was noted evidence of the grazing of *Centella repanda* along the shore of Newnan's Lake, and there were numerous fecal pellets scattered about in the area where the *Centella* had been eaten. This plant has been found in great abundance in every habitat in which the marsh rabbit has been studied in connection with this work.

Smilax is another p ant favored by captive rabbits, and it seems to occupy an important place in the diet of wild individuals. Most of the species of *Smilax* are more or less evergreen, and their leaves, dropping to the ground during the winter months, are a ready source of food.

In pulling down *Smilax* vines for the captive rabbits on January 15, I scattered a number of leaves on the ground near a blackberry brier complex occupied by marsh rabbits. Returning 30 minutes later I frightened a marsh rabbit from the spot. Next morning an examination showed that most of the leaves had been eaten, and fresh rabbit pellets were scattered about.

Fresh fecal pellets of the marsh rabbit were found on January 9 associated with the seeds of the tupelo, the pulp of which had been consumed. Trunks of the groundsel tree at Rifle Range Pond on the University campus were gnawed by rabbits during January.

Amount of Food Eaten per Day.—The amount of green food eaten by each of 3 marsh rabbits every 24 hours was ascertained during one week. The food was weighed before being placed in the cages late in the afternoon. Any that remained the next afternoon was removed and weighed to ascertain the amount consumed.

The plants given as food were chiefly *Centella repanda*, one of the favorite foods of marsh rabbits, and leaves of the sweet gum. The average amount consumed per rabbit in 24 hours was 460.21 grams. The smallest amount was 315.7 grams, and the largest was 563.2 grams. The rabbits employed averaged 1589.0 grams in weight. This experiment shows that the food consumed daily averaged 28.9 per cent of the weight of the rabbits.

Home Range.—From the available evidence the home range of this subspecies seems to be limited to a rather restricted area. Two marsh rabbits that were captured in box traps at Newnan's Lake were marked and released at the point of capture. They never were recaptured more than 100 yards from the point at which they first were trapped. Each was retaken 3 times within the 100-yard area, but no others were trapped there. One of these individuals was shot on April 22, 1935, within 30 feet of the spot in which it first was trapped and released on October 25, 1934.

Newnan's Lake forms a barrier on the east that the rabbits undoubtedly do not cross. From field observations it appears that the marsh rabbits range along the border of the swamp bounding the area on the north. The two individuals mentioned above were

captured within a few yards of the shore of the lake. When the traps were moved a distance of about 200 yards along the swamp one new individual was taken, but the first two were not caught. Moving the traps the same distance still farther along the swamp resulted in the taking of two new rabbits but no marked individuals.

From this evidence it seems that the home range of the marsh rabbit, at least in the types of habitat considered in this study, is a small area not more than 200 or 300 yards in extent.

Forms.—The marsh rabbit's form is little more than a spot in some well screened area from which leaves and twigs have been scraped away, exposing the bare soil. The bare spot generally is oval and the end toward which the rabbit habitually faces, and in which the fore-feet are placed, is smaller than the opposite end. The average form is about 12 inches long and 9 inches across in the center. In grassy areas or in blackberry thickets the form may be placed almost anywhere, as one spot is as well protected from sight as another. One found in a patch of grass at Newnan's Lake had trails leading from it in 3 directions. Those in broom-sedge were bare spots just large enough for the rabbits and had well-marked trails diverging from them.

In the more open hammocks the forms are located in sheltering bits of vegetation or among fallen limbs. One was found under a fallen tree top. Another was discovered in a small thicket of seedlings at the base of a tree. Forms also were found in palmetto thickets and protected by the large fans of the cabbage-palm, *Sabal palmetto*. The length of time during which a form is utilized probably varies considerably. Some of them at least are more than mere temporary stopping places. Two rabbits were flushed from the same forms at Newnan's Lake at different intervals between November 7 and November 24.

Length of Survival without Water.—Ten of the caged marsh rabbits were given no water. All were fed on the sorts of green vegetation that they liked. None of them lived longer than 9 days, and two of the animals died within 3 days. The 10 rabbits survived for an average of 5.8 waterless days. Autopsies, however, showed no localized cause of death, except in the case of two individuals that had lesions in the lungs that may have been due to pulmonary disease.

One of the rabbits used in this experiment had been in captivity for 15 weeks. At the end of that period the water pan was removed from its cage, and its accustomed foods were continued. Six days later it was dead.

Enemies.—The Florida wildcat was mentioned by Harper (1927, p. 322) as a predator of rabbits. Audubon and Bachman (1846, p. 6) stated that wildcats feed chiefly on rabbits and rats. The gray fox and weasel possibly are other important enemies of marsh rabbits, but there is no evidence to support this supposition.

Oscar E. Baynard told me of finding marsh rabbit remains in the nests of the great horned owl, barred owl, barn owl, marsh hawk, red-tailed hawk, and bald eagle. The great horned owl probably is the most important of the feathered enemies of the marsh rabbit, as it is the largest and most powerful of the birds that hunt at night, when marsh rabbits are most active. Mr. Baynard estimated from his examination of more than 1000 nests of the bald eagle that rabbits, both marsh rabbits and cottontails, comprise at least 20 per cent of the food of that species in Florida.

Mr. Baynard recounted to me the taking of many immature and some adult marsh rabbits from water moccasins captured at Orange Lake. He also has taken immature marsh rabbits from the stomachs of diamondback rattlers. A. F. Carr took a fully grown marsh rabbit from the stomach of a large diamondback.

Kellogg (1929, p. 27–28) reported that remains of *Sylvilagus aquaticus littoralis* were found in 3 out of 157 Louisiana alligator stomachs examined. The marsh rabbit, which is much more aquatic than the misnamed form *aquaticus*, probably falls prey to alligators more often than does the latter species.

Parasites.—The marsh rabbit, like many other members of the genus, is host to the larvae of the bot fly, *Cuterebra* sp. Observations show that the period of infestation ends about the middle of December. Thirteen marsh rabbits were examined between November 3 and December 20, and all were found to carry one or more *Cuterebra*. Fifteen specimens examined during the remainder of December, and in January and February, were free from warbles.

The period when infestation begins is not known. Two rabbits examined on October 23 and 24 apparently had no warbles, but small larvae could have been, and probably were, present and overlooked in the live rabbits. One of the animals was released and recaptured on November 19, at which time it had a large warble. In all of the animals observed the larvae were in the skin of the ventral part of the neck, or sometimes between the forelegs. Two rabbits were found with three warbles each, but the remainder of the animals each had only one or two larvae.

The exact effect of the parasites upon their hosts is difficult to determine. They at least are very annoying to the rabbits. Captive animals infested with warbles bend their heads and attempt to bite the parasites. A larva from a marsh rabbit captured on November 25, weighed 6.4 grams and was 35 mm. in length, which is representative of the average size of warbles found during November and December.

All of the rabbits observed had either ticks or fleas, or both. The ticks usually were attached to the ears, nose, or about the eyes of their hosts. Sometimes, however, they were found on the feet or other parts of the body. The ticks were determined by Dr. H. E. Ewing of the National Museum to be *Haemophysalis leporis-palustris*, but the fleas were not identified.

Internal parasites were found in but one of more than 24 rabbits examined. This single individual, shot on February 15, 1935, was parasitized by both roundworms and a tapeworm. The former, from the stomach, were identified by Dr. G. F. Otto of Johns Hopkins University as *Obeliscoides cuniculi* Graybill. In regard to the tapeworm, Dr. Otto said that "There is no doubt about its being in the genus *Cittotaenia* and since *C. pectinata* is the only one of these forms with cosmopolitan distribution in rabbits it is probably this form." The rabbit host weighed 1362 grams and was 406 millimeters long.

Diseases.—Four rabbits that died in captivity were found to have signs of pulmonary infection. Two of them had access to water, while the remaining two were among those from which water was withheld. All had lesions in one lung. A rabbit that died on November 18 had its entire left lung in a diseased and apparently useless condition.

Rabbits that seemingly succumbed to infected lungs always were listless and refused to eat for 2 or 3 days previous to death. They did not dash about or retreat to their boxes at the approach of a person. No water was splashed from the drinking pans by the two to which water was available. Breathing seemed to become more and more difficult. The rabbit fell on its side and lay there gasping loudly and spasmodically. Two or three hours after losing the ability to stand or sit erect the rabbit died.

All four of the rabbits were infested with *Cuterebra* larvae. Possibly the presence of these parasites and the somewhat unnatural conditions encountered in cage life combined to lower the resistance of the captives. Other rabbits infested with *Cuterebra* larvae did not succumb, and some of the rabbits that died in captivity apparently had healthy lungs.

Habitats.—Cottontails were observed in high pineland and associated minor habitats, while marsh rabbits were found more or less associated with water. Very possibly the borders of their range areas do overlap in some places, but in no instance were the two species noted in the same place. Marsh rabbits were found in a hammock, in low pineland, and near a weed-bordered pond.

The hammock habitat studied has been described in detail by Blair (1935). The

magnolia, white-hickory, and hackberry are the largest and most abundant trees of the hammock. Cypress, tupelo, and sweet gum comprise the majority of the trees in the swamp and along the lake front. Water is furnished to this area by Newnan's Lake, and by the small creek and swamp that bound the area on the north. Cover is produced by the blackberry, young cabbage-palms, and numerous seedlings and small shrubs. Tangles of fallen limbs and the low-growing vines of the dewberry also aid in furnishing cover. Prominent food plants are *Centella repanda* and *Hydrocotyle*, which form green mats along the shore of the lake and swamp throughout the year. Water hyacinths likewise are available at all seasons.

This hammock does not support a large population of marsh rabbits, for the investigation of which box traps were used in an area about 100 yards square. The traps were set in rabbit trails, where the animals apparently blundered into them. They at first were baited with carrots, but unbaited traps proved equally effective. One hundred trap nights (10 traps for 10 consecutive nights) yielded two specimens, one on the first and the other on the second night. The rabbits were marked and released, and were retaken on the sixth and seventh nights. These facts constitute good evidence that no other individuals were ranging through this area.

The area of low pineland studied is about two miles east and slightly north of Gainesville. The longleaf pine grades through slash pine and swamp pine into a cypress pond in which also grow black gum and bay. Water is available in the cypress pond, in which water was found during the driest months of the period of the study. Cover is furnished by thickets of saw-palmetto and blackberries. The gallberry and the chokeberry also produce some cover. *Centella*, marsh pennywort, blackberries and green briers are available for food.

Two marsh rabbits were driven from blackberry thickets in this area and shot on February 15, 1935, and one was driven from a saw-palmetto thicket. Droppings were numerous throughout the area, but were most abundant in the thickets.

The pond border studied is located on the University Experiment Station grounds, and is known as Rifle Range Pond. The entire area is about 200 yards long and 150 yards across, and is bounded on all sides by open fields. A small stream runs through the center of the area and into the pond, but drainage therefrom is underground. At the north end of the area, cover is formed by a heavy growth of blackberry briers, and south of this, a low, flat section grown up in cat-tails provides additional protection. On each side of the cat-tails there is broom-sedge, which is another important cover plant. The *Centella*, marsh pennywort, cat-tail, and rush are food plants growing around the pond margin.

This area supports a large population of marsh rabbits. Twenty-seven individuals were taken in 200 trap nights. There were well-beaten trails through the broom-sedge and cat-tails, and tracks were numerous in the mud. Fecal pellets were extremely abundant in all parts of the area. The large population of marsh rabbits probably is due in part to the great abundance of cover that is available. The area is posted against hunting and this may be another cause for the abundance of the rabbits in this place.

Factors Limiting Distribution.—In the feeding experiments it has been shown that a great many plants are acceptable to the marsh rabbit as food, and it is doubtful if food is a major factor in limiting the local distribution of the species. The bathing habit of captives suggests a preference for a habitat in the neighborhood of water. Furthermore, the need of drinking water, already noted, tends to restrict the marsh rabbit to areas having water readily available.

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THE MAMMALS OF LAKE KEDGEMAKOOGE AND VICINITY, NOVA SCOTIA

By Carolyn Sheldon

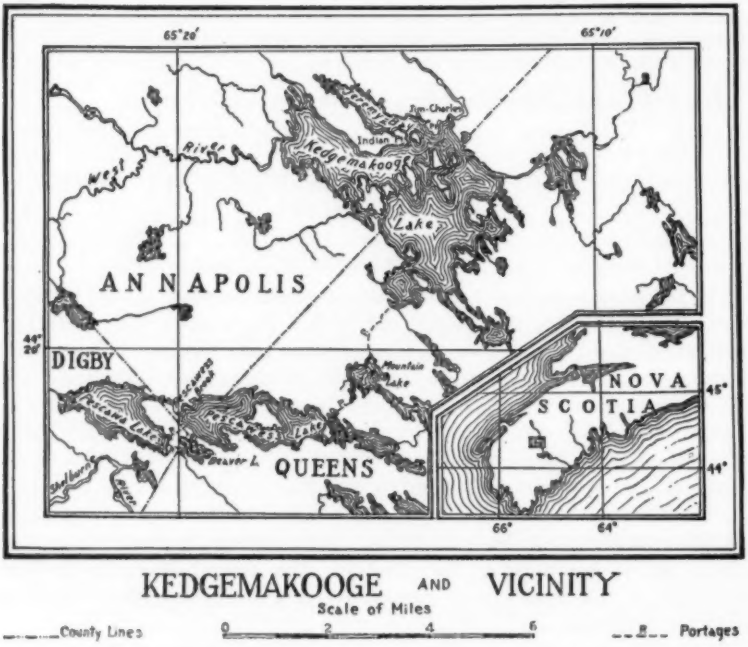
The following annotated list combines observations made during the summers of 1919 to 1928, 1930, 1932, and 1933. The seasons from early June until late September were spent in the vicinity of Lake Kedgemakooge[1], which is situated in western Nova Scotia about 30 miles directly inland. Our cabins are built on "Jim Charles Point," a wooded peninsula about a mile across the lake from, and to the west of, the dirt road which is the only means of communicatiom between the farms and the larger towns and cities on the coast. They face Jeremy's Bay and Indian Point. South of Indian Point is another long bay which parallels Jeremy's Bay. At the heads of these bays the thick coniferous forest merges into wide treeless barrens which constitute the wildest parts of the country. The general character and the vegetation of this inland Nova Scotian country has been fully described by A. L. Rand (1933).

Kedgemakooge is the second largest lake in the Province of Nova Scotia. Its shoreline is rugged, being broken by peninsulas, and by numerous rivers and brooks which form a connecting link between it and the other lakes in the vicinity. Its woodland consists of white pine ridges and large hemlock forests, interspersed with hardwoods. A day's journey leads into the highest part of Nova Scotia—the old caribou country of barrens dotted with countless clusters of granite boulders, in the shelter of which occasionally are found the dead boughs which formed the bed of an Indian hunter.

Except to the Micmac Indians, the white natives, and a few summer

[1] Lake Kedgemakooge appears as Fairy Lake on most maps.

visitors, Kedgemakooge, with its surrounding lakes and woodlands, was little known when first we went there. Few trails were cut through the woods and it still was in a primitive state. Later, lumbermen invaded the woods near us, stripping areas of hemlocks and pines and driving out many of the larger animals. To the westward the forests and lakes were wilder and at that time were inaccurately charted on available maps. We own a few acres around Beaver Lake, about 30 miles distant, and formerly spent short intervals there, living in tents pitched among the trees close to the water's edge.



Map of Kedgemakooge and Vicinity, Nova Scotia

Beaver Lake, where a large part of my observations were made, differs from the lakes mentioned by Rand in that it has no inlet, but is fed entirely by springs in the sphagnum swamps of the surrounding country. Its water is very clear, in contrast to the coffee-colored water of other lakes, and there are neither sandy nor gravelly beaches, like one finds here and there around Kedgemakooge and other lakes in that vicinity. From Beaver Lake trips easily were made by foot and by canoe into the far interior.

I am indebted especially to Allister Nixon of Maitland Bridge, Nova

Scotia, for allowing me to include some of his personal observations in this article.

ACCOUNTS OF SPECIES

Sorex cinereus cinereus.—Masked shrew. This species, usually in pairs, was found everywhere—in swamps, forests, fields, and barrens. Numbers were taken in live and in snap traps. Once I succeeded in reaching the trap sufficiently soon to prevent the death of the tiny animal. When transferred from the trap into a cage, he at once began to eat some earthworms. He then became very lively and ran ceaselessly all over the cage wire, seeking to escape, continually uttering a twittering sound. Some time during the night he escaped.

Once or twice I had the opportunity of watching a masked shrew in the woods. On June 5, 1933, about 10.30 A.M., a rustling of dry leaves drew my attention to a tiny brown form darting busily from place to place. I remained motionless and the shrew apparently was oblivious of my presence. He covered hardly more than 5 or 6 square yards within the time, but every nook and cranny and the underside of every leaf, was explored, his long flexible nose lifting sticks and leaves. Several times he disappeared into a tiny hole or under the leaves, only to reappear, never still for an instant. The next morning, at the same time, I watched the shrew once more. He always made a great deal of noise rustling around in the leaves, but one could not have seen him unless the place were watched closely.

Sorex palustris gloveralleni.—Water shrew. I never took this species, but my brother caught 2 or 3 along the shores of Beaver Lake.

Blarina brevicauda talpoides.—Short-tailed shrew. The short-tailed shrew is one of the most common of the small mammals. It is found in every type of habitat, but usually not more than a single pair is taken at one place. It seems especially fond of damp, cool rock crevices and often is caught under tree roots where the rocks are cold and wet.

Unless the traps were visited soon after capture, the shrew was found dead, but I managed to procure 5 or 6 live ones. They were exceedingly quarrelsome and if more than 2 were confined together, one always was killed. Often it was impossible to keep more than one in a cage. They fought continually over food, while squealing shrilly. They ate quantities of angle worms and the bodies of small mammals, often devouring with apparent relish flesh which already was infested with maggots. Moths, beetles, rolled oats, and a few sunflower seeds were eaten readily.

When transferred into a cage, the shrew at once burrowed beneath the moss and leaves, rarely emerging into full view. When food was given, the little animal explored the cage, traveling under the leaves, but sticking up its nose in one place and another until it located the food, which always was pulled under the surface, whether eaten at once or not. Cans of nesting material were filled with earth, and the water-can always was overturned and stopped with earth. Peanuts were found stored in one can, the entrance of which was plugged with earth.

Several times I observed these animals drinking. They took a mouthful of water and tipped back the head to swallow it. I watched one come up for a mouthful of water, disappear under the earth on the cage floor, return a second later for another mouthful and so on for 5 or 6 times. He seemed to be transporting the water in his mouth. The earth or sawdust on the cage bottoms always was found to be very moist, even if it was dry when put in place. Once I pulled a shrew out by his tail and found him hanging to the nose of his cage mate, both animals squealing loudly.

A live deer-mouse was placed in a cage with a shrew that apparently was very hungry. Soon he sensed an alien presence and began sniffing around to locate the mouse. He

never approached the latter on top of the moss but only beneath it. The mouse soon realized this and ran to another part of the cage at the shrew's approach, often clinging to the wire near the top. The shrew several times climbed about the wire, sniffing continually. Apparently he could not see the mouse, as several times he approached so near as actually to touch the latter before knowing it was there. Once he grabbed the mouse's tail and tried to pull it under the moss, but the mouse was too strong and finally escaped. A second time the shrew caught hold of the tail as the mouse clung to the wire, and almost succeeded in pulling his victim underneath, when the tail broke. The next morning the mouse was found dead and nearly consumed.

After a month or more in captivity the shrews become very fat and rather sluggish, but the fur always was kept smooth and shining. The cage needed cleaning quite often. If left too long it was found infested with hundreds of tiny red spiders, although other insects were cleaned out by the animal.

Myotis lucifugus lucifugus.—Little brown bat. This and one other species of bat unknown to me are found everywhere around Kedgemakooge, often using an old log cabin in which to sleep. They also found their way between the framework of board cabins and could be heard during the day moving about and squeaking. The native guides told me of a cave in the barren county which bats use for shelter, but I did not visit it. My brother found bats hanging in the cleft of a split granite boulder, in the middle of a river.

Euarctos americanus americanus.—Black bear. Bears are not often seen near human habitations, but they are fairly abundant in the wildest parts of the country. The natives trap them throughout the year for the bounty. During the summer of 1933 they were particularly numerous and a few were seen near our cabins. In early June, with another girl and Allister Nixon, I was paddling over a lake about 2 miles from Kedgemakooge. A moving black object on the shore first attracted us, but we were too far distant to determine with certainty the identity of the animal. We turned in that direction and landed after it had disappeared from sight. We approached the sound of crashing in the bushes and caught sight of 2 yearling cubs scrambling up a pine tree about 100 yards distant. The wind was favorable and they had not yet seen us. As we drew near we suddenly were aware of a movement in the bushes not more than 25 yards away, and caught just a glimpse of an old bear, evidently the mother of the cubs, headed in our direction. We ran for the canoe and when she saw us retreating she stopped. Evidently she had been lying down close to where the cubs were playing and when she heard us, arose to investigate. This was my only encounter with a bear in all the summers spent in Nova Scotia. Once or twice I found fresh signs of their presence, such as rocks turned over, or droppings, once very fresh, only about one-half mile from our tents at Beaver Lake.

Mustela vison vison.—Mink. Mink are very numerous around the shores of the lakes. At one time a mink swam so near our canoe that we could have captured him in a fish net. With no apparent fear he approached, diving again and again all around us. He mounted a rock projecting about a foot above the water and calmly surveyed us for a minute or two before taking to the water again.

One summer we kept a pair of young black-backed gulls on the shore of the lake near our cabins. After their feathers were fully grown we found one of them lying dead on the shore, its head eaten, while the other had disappeared. The following morning a trap set nearby held a large mink.

Mustela cigognanii cigognanii.—Weasel. Weasels were very seldom seen by us, although trappers often catch them in winter. One native told me that he had spent the winter and early spring in an old log cabin, engaged in lumbering. He found the deer mice very abundant and for many weeks a weasel used the cabin as a regular hunting ground.

Only once did I see a weasel. He came from under our cabin, mounted a nearby rock, and stood on his hind legs, before disappearing into the woodpile. Probably he was after the tame chipmunks.

The fearlessness of the weasel is well illustrated by the fact that my brother watched one with the aid of a flashlight as it hunted for mice in the little supply cabin at Beaver Lake.

Lutra canadensis canadensis.—Otter. The otter is practically unknown among the inland lakes near Kedgemakooge, but an occasional pair has been seen on Little and West rivers. I once caught a glimpse of what I thought was one in Beaver Lake near our camp. A mammal, seemingly larger than a mink, rose to the surface with a small fish in its mouth, swam several yards and then dove again. Accounts of their occurrence in that region are contained in a report for 1932 of the Department of Lands and Forests of the Province of Nova Scotia.

Mephitis mephitis mephitis.—Skunk. The skunk is better known in the farmlands than elsewhere. The only one I ever saw in the woods near the cabins entered a trap set for woodchuck at the entrance of a burrow recently vacated. My brother reports having seen 2 at Beaver Lake.

Vulpes fulva rubricosa.—Red fox. The red fox very rarely is seen now. Allister Nixon wrote that probably there are not more than a half dozen foxes around Kedgemakooge. He believes this is attributable to the scarcity of rabbits.

When we first began visiting Kedgemakooge the nearby forests seldom were penetrated and the only fox I ever saw in this region was in dense second growth of spruce and balsam about 3 miles from the cabins. In that vicinity we also found a few tracks along an old lumber road, but not in later years.

Canis lycaon.—Wolf. The wolf, although rare in Nova Scotia in the latter part of the ninteenth century, probably existed until the disappearance of the caribou.

Lynx canadensis canadensis.—Canada lynx. The only reports of lynx in this part of the country come from Allister Nixon, who says that one was caught along West River several years ago, and that he saw tracks once in the winter of 1934–35, and also during the preceding year. The animals were travelling northwest, both in the same locality.

Lynx rufus rufus.—Bobcat. I never saw a sign of a bobcat during the years spent in Nova Scotia. From a canoe my brother saw one in the early evening at Beaver Lake, crouching on some boulders by the huckleberry bushes on the banks. The animal had been drinking and, after watching the boat a few seconds, it silently disappeared into the forest. The natives report catching bobcats in snares during the winter, or hunting them with dogs, for the bounty.

Allister Nixon is an authority on the bobcats of that region and the following is an extract from a letter of his, dated May 14, 1935. "Wildcats are gaining in numbers quite fast this last couple of years and are plentiful around Kedgemakooge Lake on all four sides, especially the Mount Tom country, as that is very rocky, full of granite ledges and places where they breed their young. That is also full of small swamps, good rabbit country. Rabbits used to be their main food. but the rabbits are now very scarce and, as there is plenty of other breeding country, the cats range over a large area. Whereas wildcats are killers and food being scarce of late years, they have been killing deer, full grown animals, as I have found the freshly killed deer and the cats not fifty yards from the carcase on snow." This statement referred to Sunday, March 18, 1934, in a back bog about one mile east of Channel Lake. Mr. Nixon continued as follows:

"Also I may say they, in a great many cases, have two litters of kittens, the second about August. At the age of twelve weeks the kittens are about the size of a large house cat, and in numbers about the same as the house cat to a litter. As soon as they are six months old they hunt their own living and I am not sure how much younger, but at that age I am positive they hunt alone. My experience in hunting them is with hounds

following their trails. I always knew what they were feeding on and the amount of food it required to satisfy a full grown cat; one rabbit a night would be their limit, either large or small, and swamps and thickets their hunting ground."

Marmota monax canadensis.—Woodchuck. Woodchucks are common on farms, but rare near us. One or two were caught near the cabins around the edge of an old Indian garden, and one had a hole under a thick patch of roses. Now there are no woodchucks left.

Tamias striatus lysteri.—Chipmunk. Chipmunks are very common everywhere. They are tamed easily and are so numerous around the cabins that they become pests, getting into everything left within reach and even entering the cabins in search of food. They became so bold that more than once I have seen them narrowly escape the talons of a hawk, one of which swooped so near that his wings almost brushed the ground at the doorstep of our cabin. Chipmunk holes are everywhere. No sudden increment was apparent, but their numbers had increased greatly by 1933.

Not only did the animals eat all nuts and seeds placed for them, but even the bodies of mice that we had skinned. In nature I have known them to eat bunchberries, a red mushroom of the genus *Russula* and, in the early spring, catkins of the white birches.

Sciurus hudsonicus gymnicus.—Red squirrel. The red squirrel is common in the coniferous forests. We always killed them around the cabins because they chase away the chipmunks and are known to destroy the eggs and young of birds. In 1923, when the woods a mile or so away from us became stripped of its pines by lumbermen, we had a large invasion of red squirrels in search of green pine cones around the cabins. In the same year we noticed a sharp decrease in the number of birds. That summer more than 200 squirrels were killed by us on this point alone. Since that year few have been noted near us. We found their flesh to be excellent eating, something like that of grouse.

Glaucomys sabrinus macrotis.—Flying squirrel. The flying squirrel is quite plentiful, although seldom seen because of its nocturnal habits. Occasionally one took up quarters in a cabin before the screens were put on for the summer. We found one nest constructed of hanging moss at the top of a young spruce whose dense branches nearly hid the structure from view.

In 1932 I caught a youngster in a snap trap set at the foot of a dead hollow tree in a swamp. No others were taken or seen at that place. In early June of 1933 we found a a female with 3 young in a hollow tree on the lake shore, about 100 yards from the cabins. We captured the old one in a net and then found the young, with eyes still closed, in a nest of moss inside the tree. All were transferred to a small screened porch. During that day the mother stayed quietly with her young in a cardboard box. That night she escaped from the cabin and never returned.

I attempted to raise the young on canned milk, but the weather was so cold it was difficult to keep them warm, and finally they died. They were covered thinly with brown hair on the backs, with a narrow strip of black on the sides, and white hair on the underparts.

Castor canadensis canadensis.—Beaver. Beavers are very common in Kedgemakooge and in all of the lakes near us, building their houses in bays surrounded by bogs and swamps, or on the banks of rivers. At Beaver Lake they built 5 or 6 houses, each in a different bay. They dammed the outlet, dug channels, and wore paths through the boggy ground which constituted most of the shore. Their cuttings were apparent all around the lake. We floated a young poplar in front of our tents and the first night a beaver stripped it of bark. Soon afterward unlawful trapping extirpated the beavers in that region for several years. In the summer of 1933 a beaver was known to be in Beaver Lake because of fresh cuttings seen, but if any stay there, they probably will be trapped out again.

In Pescawess Lake, about one-half mile from Beaver Lake, we found a beaver house and watched 2 young swimming fearlessly near us for 15 or 20 minutes.

Peromyscus maniculatus abietorum and P. leucopus noveboracensis.—Deer-mouse. Deer-mice of two species are very abundant everywhere in the woods and in the cabins. For years they constructed nests of any available material between the stone chimneys and board walls of the cabins. After dark they came out and frisked around the rooms, on the floor, on the shelves, and up and down the walls. Once in the middle of the day a female ran across the hearth of the fireplace carrying a blind, hairless young one in her mouth. Apparently frightened by our presence, she dropped her burden, which lay wriggling helplessly until she returned for it. Several times she made the trip from one side of the chimney to the other, each time transporting a young one in her mouth.

In the summer of 1933 there were almost no deer-mice in the cabin. This may be attributable to the fact that no food was kept there, as had been the case in previous years.

Outside, deer-mice were caught in runways used by other mice as well, and one was taken at a hole bored about 6 feet from the ground in a large hemlock. At Beaver Lake they entered the small storage cabin and made nests among bedding and clothing left within their reach. When we closed the camp in the fall we always set 2 or 3 dozen snap traps in the cabin and the following spring every one held a mouse.

Synaptomys cooperi cooperi.—Lemming mouse. I caught only 3 lemming mice in all the years I was in Nova Scotia. They were very scarce and repeated efforts to secure them were in vain. Those taken were caught on a faintly defined runway crossing a moss-covered log in a sphagnum swamp. Although they were reported not to be attracted by bait, one of these specimens had in its mouth a mixture of peanut butter, bacon, raisins, and rolled oats, which was being used as bait.

Clethrionomys gapperi ochraceus.—Red-backed mouse. Red-backed mice are found everywhere except in open meadows. Their holes and runways are common in the forests and swamps. The habits of those observed around our camp at Beaver Lake have been previously described by me (1930). In captivity they make delightful pets, becoming very tame and amusing. They seem to be equally diurnal and nocturnal.

Definite fluctuations in the numbers of this species were observed. In 1928 they were very numerous, but the following year, very scarce. In the summer of 1933 they were more abundant than I ever have known them to be, and frequently were seen running around in the woods during the daytime.

Microtus pennsylvanicus acadicus.—Meadow mouse. Meadow mice were taken in fields and sphagnum swamps near patches of sedge and grass. Their runways plainly were visible and the favorite feeding places littered by droppings and grass cuttings. I noticed a sharp decrease in their numbers in 1933, although that was apparently a favorable year for other mice.

Ondatra zibethica zibethica.—Muskrat. Muskrats are common in lakes and in rivers with muddy bottoms. At Beaver Lake we often saw one rapidly swimming, towing a small leafy branch held in its teeth. They use the channels and runways made by beavers in the bogs. Often patches of the lake were stripped of lily pads and only the stalks left sticking above the surface. This undoubtedly was done by muskrats.

Zapus hudsonius hudsonius.—Meadow jumping mouse. This mouse was found in meadows and grassy areas around the shores of the lakes and rivers, or in meadows sometimes several miles from water. Often, near grass in the sphagnum swamps, its range overlapped that of the woodland jumping mouse. Of its habits I previously have written (1934).

Napaeozapus insignis insignis.—Woodland jumping mouse. This animal is most abundant in sphagnum swamps; I collected a few specimens in drier forested areas around the lakes and rivers. I published a note (1934) in regard to its habits.

Erethizon dorsatum dorsatum.—Porcupine. Porcupines are very numerous in the hardwood and coniferous forests, and even in bogs, near their edges. They were seen at the tops of white birches, poplars, apple trees, and hemlocks. Frequently a den was

found beneath the upheaved roots of a large hemlock. They also took refuge in old log cabins used by trappers in the winter.

In 1933 I found a young porcupine sitting on a stump at the foot of a tall hemlock, in the top of which was his mother. I captured him easily by covering him with a canvas sack. When brought home he was placed on a screened porch, with fresh branches of birch, poplar, and hemlock, and water. He would neither eat nor drink, but sat on a shelf staring out at the woods and crying piteously. He refused to make friends but would bristle up fiercely at the sound of my approach. After a night of continuous wailing I put him outside in a rather flimsy pen covered with boards and branches of hemlock. He escaped the second night and I never saw him again. A second captive youngster acted in an entirely similar manner.

Porcupines apparently are good swimmers for short distances. One was seen nearly exhausted in the lake about one-half mile from shore. When a paddle was extended to him, he clung to it until landed on the beach. He did not survive, however, as only a heap of quills and fur remained when we looked for him a few weeks later.

Lepus americanus struthopus.—Snowshoe hare. Snowshoe hares were subject to marked fluctuations. Dogs kept near us at Kedgemakooge destroyed many on Jim Charles' Point where formerly they were abundant.

We were fortunate one summer in finding the nest of one a few yards from one of the cabins under a small pine tree. In it were 4 baby rabbits, lying in a little hollow lined with leaves and pine needles, well screened from view by the thick low branches of the pine. At the time we did not note very accurately the size of the young hares, but, to my memory, they were probably not much more than 5 inches long.

At Beaver Lake we made brush piles to attract rabbits, but I do not remember ever having found them very abundant in that vicinity. One used to come timidly and eat bread thrown out near the tents, but before long he disappeared.

In the summer of 1933 there was no dog at Kedgemakooge, and the rabbits were increasing steadily. We captured 3 young which we kept inside a screened porch. They became very tame and easily could be handled. They ate almost everything in the way of green food, as well as rolled oats and bread. We released them at the end of the summer when they were nearly full-grown.

Odocoileus virginianus borealis.—White-tailed deer. Deer were introduced into Nova Scotia about 1894 and have increased very rapidly. They have become so numerous that they are considered a serious competitor of the moose in regard to food supply. No estimate has been made of their present numbers, but Allister Nixon believes that within a radius of 5 miles of Kedgemakooge there are between 500 and 700. The first 2 or 3 years that we were there, they often were seen near the cabins, but were very shy, and the increase of summer visitors scared them away. Later the lumbermen drove them still farther.

It has been reported that during the open season of 1932, 4,866 deer were killed. I never have known them to be so numerous as they were in the summer of 1933. Farmers everywhere were obliged to kill them because they ruined gardens. On our side of the lake they frequently were seen near the cabins in spite of the people present. Early in June I stood on the porch of our cabin and watched a large doe, apparently unconscious of my presence, walk back and forth in the woods not more than 10 feet away.

During the course of a half-hour's paddle toward the head of Jeremy's Bay, 4 or 5 deer always were seen. They were most in evidence early in the morning or toward evening, but they were abroad in the middle of the day as well. As 1933 was an unusually dry summer, the deer came to the lake shore for water, and it is probable that for that reason many more were seen.

In 1933 I received several reports of partial albino deer having been seen.

Alces americana americana.—Moose. Moose are very numerous in the unfrequented

parts of the wilderness, near swamps and bogs traversed by game trails. No estimate has been made of their numbers, but again I would like to quote Allister Nixon. His opinion is that within a radius of 5 miles of Kedgemakooge there are about 150 moose.

In the first years of our stay in Nova Scotia a few moose were seen near the cabins, but in that vicinity they stayed mostly close to the wide barrens at the head of Jeremy's Bay.

Moose are powerful swimmers and frequently they cross a mile-long stretch of the lake between Indian Point and the other side of Jeremy's Bay. One morning, we saw a dark form slowly moving across the lake, 3 or more miles in front of the cabins, and field glasses revealed a swimming bull moose.

Bulls more commonly are seen in the rutting season, from late September to the end of October. At that time they are restless and wander many miles in search of cows, and come to almost any sound resembling the call of a cow. One night about the middle of September, several of us were practicing moose calling at the camp at Beaver Lake. Any nearby moose would have detected the deception, but about one-half hour after we had ceased, a bull was heard grunting loudly and approaching rapidly along the shore. He got our scent however, and fled. He must have been many miles away. Moose are very curious about any unusual sounds and often come many miles to investigate the sound of a motor boat or wood chopping.

A letter dated February 13, 1934, from F. A. Harrison, Chief Clerk of the Department of Lands and Forests in Halifax, contains the following statement: "Moose in this Province are very plentiful at the present time, having shown a considerable increase during the past 35 or 40 years. They probably reached their peak about the year 1922 and since that time have about held their own." In 1926 moose were very abundant, but after that a sharp decrease was noted in their numbers and there were many reports from guides that moose carcases had been found.

Rangifer caribou caribou.—Caribou. These animals are reported to have become extinct in Nova Scotia in 1900. At least they roamed the country in 1895, and many guides remember having heard of them.

On May 14, 1935, Allister Nixon wrote as follows: "As to what I know about caribou. They stopped coming here about thirty odd years ago. Previous to that they crossed both north and south of Kedgemakooge going west in the fall, returning in the spring and spent the time in between on the upper Shelburne River and Roseway country, also in Queen's County west of Rossignol. As you know, both rivers (Shelburne and Roseway) are in Digby and Shelburne Counties. They (caribou) also took in part of Yarmouth County."

Well-beaten trails, probably made originally by caribou, cross the high treeless ridges between lakes. The gray lichen on which the animals fed is plentiful. It is reported that the last caribou on Cape Breton Island were killed in 1915. Reliable observers who were there about 1923 tell me that a few old tracks were the only evidence of the animals.

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SNOWSHOE RABBIT MIGRATION, TICK INFESTATION, AND WEATHER CYCLES

By W. T. Cox

For many years, the periodic abundance or scarcity of the varying hares or snowshoe rabbits has been observed and discussed. Lumbermen and early settlers in northern Minnesota, Wisconsin, and Michigan commented on the startling variations in the numbers of these animals, that at times were so abundant that they threatened to destroy all young growth in the forest, and at other times were exceedingly rare. The Indians especially were concerned about these fluctuations, for to them the rabbit was an important source of food and of light rabbit-skin blankets. The records and the reports of officials of the Hudson's Bay Company for western Canada show statistically that there have been more or less regular periods of abundance and scarcity in the rabbit population for the past 75 to 100 years.

While a great deal of study has been devoted by R. G. Green, J. E. Shillinger, Ralph King, and others to the subject of diseases among rabbits, in an attempt to solve the mystery of these fluctuations, little attention so far has been given to the subject of migrations. The importance of tick infestation also may not have been stressed sufficiently. It cannot be questioned that there occur rabbit migrations on an enormous scale. It is reasonable to assume that these in part are responsible for the "highs" and "lows" in the rabbit population of a district. When ticks become too numerous locally, a migration of the rabbits to new territory may be the means of giving them a new lease on life.

Maximum population in one district does not correspond always with a comparable condition elsewhere. The disappearance of rabbits around Lake of the Woods may occur one, two, or even more years after their disappearance north of Lake Superior, 300 to 400 miles distant. Frequently when rabbits disappear quickly, the number of carcasses remaining is disproportionately small, even if allowance be made for those concealed or devoured. Old-timers and Indians often tell of occasions when the rabbits left certain districts and traveled away in one direction, so that few, if any, remained. The most recent maximum in the rabbit population in Cook County, Minnesota, was in the winter of 1929–1930, while one occurred around Lake of the Woods during the winter of 1934–1935. At present, rabbits are only fairly numerous north of Grand Marais and southwest of Brainerd. They were very scarce in the summer and autumn of 1935 north of Red Lake and in Koochiching County, but since have reentered that district in considerable numbers.

As an illustration of abundance and scarcity, I may mention that in Lake and Cook counties in 1911, and in Itasca Park in 1922, snowshoe rabbits were so plentiful that I often demonstrated the possibilities of a 22-caliber revolver by standing on one stump and killing six rabbits with as many shots. This

will give some idea of the density of the rabbit population. It was observed that during the periods of abundance just cited, the rabbits were heavily infested with ticks, which literally covered them. The rabbits, moreover, easily were killed. A 22-caliber bullet striking the animal anywhere in the body seemed sufficient to cause instant death. In other years I have seen the snowshoe rabbit stand a good deal of punishment before succumbing. It is my belief that as a result of heavy tick infestation the rabbits are unable to withstand any considerable shock, and that probably also, they fall an easy prey to disease.

During the minimum in the country north of Lake Superior, in 1913 and 1914, and in Itasca County in 1924, I traveled on snowshoes extensively and in the course of one trip of two days duration saw the tracks of only one rabbit. On another trip of three days, not one track was seen, even in swamp territory ideal for these animals and where a couple of years previously they had been abundant. In a period of abundance, the rabbits by no means are evenly distributed over a territory. They literally may be swarming in some parts of a district and, for no apparent reason, only moderately plentiful in other parts of the same region.

On March 1, 1912, there was a notable abundance of rabbits in the district around Blackduck, Northome, and Kelliher, Minnesota. Upland and swamp alike were thickly populated with them. They had consumed a large part of the smaller vegetation and girdled thousands of pine, spruce, and other trees, some of them several inches in diameter. The forest appeared ghostly with white, hopping forms and freshly peeled trees and bushes. It was noted, however, that certain individual trees of the same species as those girdled were left uninjured. Whether they thus were spared because of an objectionable taste or smell, or because they happened to be coated with ice, the fact remains that about one tree in 50 or 100 remained ungirdled. This sparing of certain trees has since been observed in other areas where snowshoe rabbits were short of suitable food and had resorted to a fare of pine and spruce bark. The young thickets of pine are heavily thinned but seldom ruined by the rabbits. The fear expressed by some foresters that the snowshoe rabbit will prevent reforestation may be allayed by considering the many and widespread areas now covered with young pines and spruces in all stages of growth. It is evident that these escaped destruction by the rabbits in past periods of their abundance.

With Ranger Winslow, I drove by team from Kelliher through this forest, to the southeast shore of upper Red Lake. From there, in company with Albert Smith, a trapper who still lives on the north shore of the lake, I travelled by snowshoe across the lake to Smith's cabin at the mouth of Deer Creek. Within the next three days, we journeyed by snowshoe across the big bog and heavily forested region north of Red Lake, reaching the Rainy River at Baudette.

All the way from Kelliher to the lake it was observed that those rabbits in motion all were hopping toward the northwest, and every track in the snow pointed in the same general direction. This aroused my interest, and when Smith and I started across the wide expanse of the lake, rabbit tracks, heading northwestward, continued to be abundant. It was not until we were within 6 or 8 miles of the north shore, however, that we began to encounter rabbits sitting here and there and in groups wherever there were patches of deeper snow on the ice. Undoubtedly they had misjudged the extent of this open space and had been overtaken by daylight while still far from shore and shelter. They are loath to move about and attract attention in the open during daylight.

As we approached the north shore, the animals became more numerous, and I estimated that there were from 20 to 50 of them per acre. It was when we were within 100 yards of the wooded bank that we saw evidence of one of the tragedies of the rabbit migration. From this point to the shore and into the woods beyond, there were countless spots of blood and hair where rabbits had been killed. The fringe of hardwoods on the bank was alive with owls and several species of hawks. Great horned owls were the most numerous, but there were many snowy and several great gray owls. It was a regular slaughter place for rabbits, since the open frozen lake afforded them no protection. The big birds simply could select a victim as he hopped toward shore, make a leisurely sally, and drop on the next meal. Some of the victims had only the heads missing, while of others only a portion of the viscera had been devoured. Evidently some of the birds were becoming surfeited. Along 40 rods of this shore I identified 109 separate fresh kills, and many older ones were partly or wholly concealed by drifting snow. Apparently the same condition prevailed along miles of shore line.

Thousands of rabbits had fallen victim to these raptors during the space of two or three days. And yet plenty of rabbit tracks continued past this slaughter line and into the woods beyond. Rabbits seemed just about as abundant for the first few miles north of the lake as they were south of it. Probably the owls, although gathered here from a large territory, had little effect on the great numbers of rabbits crossing the lake.

By the middle of March scarcely a healthy rabbit could be found in a large territory southeast of Red Lake. Some sick or weak ones, a considerable number of dead ones, and evidences of rabbit kills were observed by the rangers. The next summer and for a year or so thereafter, snowshoe rabbits were exceedingly scarce around Kelliher. I had occasion to be in that locality a number of times during 1912 and 1913, and paid particular attention to the scarcity of rabbits. It then was my opinion, since strengthened by observations in the Hudson Bay country, that with the disappearance of the snowshoe rabbit there is a very serious increase in the destruction of ruffed grouse and spruce grouse by predators. This loss of game birds by owls,

hawks, foxes, weasels, and other carnivores is particularly noticeable immediately after the rabbits have left a district. The territory then is overpopulated with predators that had been attracted to the district by a maximum rabbit population. Within a year thereafter a readjustment takes place, partly as a result of predator migration. Weasels especially have been noted as becoming numerous in territory adjoining that from which rabbits recently had disappeared.

The snowshoe rabbit, of course, is not the only creature of the north that occasionally is seized with a desire to migrate. The lemmings of Scandinavia are notorious for their migrations, even into the sea. Once I witnessed an extensive movement of porcupines across the Rocky Mountains in what now is Glacier National Park. At the time I was delayed by an early, heavy snowfall while camping with F. N. Haines on Flat Top Mountain. One morning, dark streaks were observed extending downward at various angles from the saddles or gaps in the mountains to the east of us. Later in the day, these streaks appeared to be much longer and at the lower end of each there could be discerned a dark speck. Through binoculars these spots were seen to be animals floundering downward in the deep, soft snow. As they reached lower levels not so far distant, they proved to be porcupines. From every little gap there poured forth a dozen or 20, or in one case actually 55, of these animals, wallowing down to timber line on the west side. Hundreds of porcupines were crossing the main range of the Rockies.

Caribou herds likewise make long pilgrimages, and moose quit one district en masse to take up residence in another. Gray squirrels swim the Mississippi River, as they did in 1928, when thousands crossed from Wisconsin into Minnesota.

Whether the impulse to migrate is the result of hunger, of fear, or of a longing for adventure, it is difficult to say. The snowshoe rabbit may be following a blind but useful impulse when it leaves its sick companions in over-populated, over-eaten, tick infested, and disease-ridden area to seek new, clean pastures.

There is some evidence to indicate that ticks, as well as rabbits and many other upland creatures, increase rapidly during dry periods, so that after several successive dry years there is a heavy population of ticks. The effect is cumulative. As the rabbits and grouse increase, conditions are made more favorable for the propagation and distribution of the ticks until finally the latter become so numerous that they scarcely are able to find standing room on the rabbits. During the maximum of tick population, the individual ticks to me seem to be more active than at other periods. For instance, they travel more quickly across one's hand and take hold more readily. At this stage, the drain on the rabbit's vitality surpasses its powers of resistance, and it becomes weakened to the extent of being unable to forage for food. The latter is needed in greater quantities under the circumstances and, this at a time when

the best and most available kinds already have been consumed: Hence the heavy mortality. Always there are some individuals better able than others to withstand punishment and privation. There may be occasional individuals among the rabbits that are less susceptible to attack by ticks, just as there are occasional trees left ungirdled by rabbits. Such animals as remain strong and active might be prompted to migrate in search of a better food supply, and possibly to escape contact with their dead and dying companions.

The fact that one district may be dry for a longer period than another, or at a slightly different time, might account for the fact that maximum and minimum periods of abundance vary as much as several years in different localities. The continental cycles of wet and dry periods would account in general for the broad ten-year rabbit and grouse cycles.

During a series of dry years, conditions are favorable for upland species, such as grouse and rabbits, for a number of reasons. There is a wider range of suitable food and cover; there are better opportunities for nesting and breeding; the young are kept warmer and drier during the tender juvenal stage; suitable food for the young is more abundant and easier to obtain; there is a wider dispersal of the individuals and, therefore, less danger from predators and disease.

On the other hand, wet cycles favor an increase of ducks, muskrats, and other aquatic animal life. It has been observed that the muskrat cycle is approximately the reverse of that of rabbits, and the reason is evident. During a series of wet years, waterfowl and muskrats increase because of an extension of marsh and water areas suitable for their nesting and breeding sites, and for food and cover. There is a wider dispersal of aquatic species and thus greater immunity to enemies and disease. A wet period even of two years is sufficient to cause a tremendous increase in the number of these animals. Muskrats have several litters of young annually and when streams are high and lakes and ponds are full of water, the areas suitable for habitation by the rats may be many times greater than during dry seasons. This means that there is available infinitely more food and this in greater variety. Of equal importance is the result that the muskrats are widely dispersed and much less subject to loss from predators and disease than when concentrated thickly in small areas.

With the advent of dry seasons, conditions are reversed and muskrats decline rapidly in numbers. Not only is their habitable territory reduced, with consequent losses because of crowding, but in cold regions they suffer heavy losses in another way. As the water becomes shallow, winter food is frozen and rendered unavailable. The continued subsidence of lakes after ice has formed renders the houses and bank holes of the muskrats uninhabitable. Millions of them die from exposure to the cold and from lack of food. It is small wonder that there are tremendous and rapid fluctuations in the muskrat population.

It is well not to be too positive in attempting to explain wild life phenomena. Thus in venturing now to suggest that ticks rapidly increase during dry years and decrease in wet and consequently cool years, I do so with some hesitancy. With even more hesitation I venture the suggestion that ticks may be the prime cause of the heavy mortality that overtakes both hares and grouse in the north country. I am inclined to believe, however, that they play an exceedingly important part exclusive of their rôle as vectors of disease. When an animal literally is covered by ticks there must be a heavy drain upon its vitality, a serious loss of blood, and the skin must be in no condition to function normally. With such heavy tick infestation, even were no disease prevalent, it would not be surprising if most of the hares and grouse should succumb. It must be assumed, however, that the usual diseases, such as tularemia, to which grouse and hares are susceptible, are present; that the dense population during a maximum results in more certain and more frequent contacts between individuals, and that the weakened condition caused by tick infestation renders the spread and the progress of diseases and of parasites quicker and more deadly.

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NOTES ON THE HABITS OF THE MOHAVE GROUND SQUIRREL

By William Henry Burt

When Grinnell and Dixon wrote their "Natural history of the ground squirrels of California" (Monthly Bull. State Comm. Horticulture, Calif., vol. 7, nos. 11–12, pp. 597–708, 1918), they stated that "The Mohave Ground Squirrel, although first discovered in 1886 by Mr. Frank Stephens of San Diego, has remained about the least known of all our rodents." Almost the same statement might be made today, at least in regard to the habits of this desert rodent. A few additional specimens have been collected at a few more localities, and this comprises about the only increment to our knowledge of these squirrels since Grinnell and Dixon wrote of them 18 years ago.

During the spring of 1931, while at the California Institute of Technology, I started a study of the life history of the Mohave ground squirrel (*Citellus mohavensis*), but before this fairly was begun, the intervention of other duties caused a delay in my proposed program, and I was unable to carry it to completion. During my short time in the field, however, I did gather a few notes which seem worthy of record and I present them here. These studies were made near Palmdale, California, which is at about the southwestern edge of the range of the species.

Habitat.—In its more or less restricted range the Mohave ground squirrel usually is found on the lower desert, but penetrates the Joshua tree belt in

certain places. Its preferred habitat in this part of its range seems to be where the soil is sandy or of sand mixed with gravel, with a rather sparse growth of sage brush. Near the town of Palmdale, where these squirrels were seen, the general topography is fairly level, with a few ravines of just sufficient depth for drainage. The soil is of sand mixed with coarse gravel and is fairly easy to excavate. The area is covered with sage brush and other small bushes, but is fairly open. The small bushes are 20 or 30 feet apart and not more than 2 feet in height. I never saw the squirrels in the foothills.

Abundance.—In the spring of 1931, before the young were born, these squirrels were not at all numerous in the vicinity of Palmdale. I never saw more than 3 or 4 to the mile, and often none for 2 or 3 miles. I estimated roughly the number to comprise between 15 and 20 individuals per square mile, although I feel that this figure is rather high. They were distinctly less numerous than either *Citellus beecheyi* or *Ammospermophilus*, both of which were found in the same territory. As far as I could learn there had been no poisoning activities in this particular locality for some time. These squirrels apparently do not live in close colonies, but are well scattered over the area where they occur. During the mating season two squirrels may be found close together, but I never saw more than this number within a radius of one-quarter mile.

Activities.—My observations indicate that in cloudy weather these squirrels are less active than they are on clear, warm days. April 5, 1931, was a cloudy day and I saw only 2 squirrels, although I spent more than 6 hours seeking them, and covered a considerable area where previously they had been encountered.

These animals rarely run rapidly for any great distance, as usually they are near the entrance to a burrow. When danger threatens they dodge into a hole and almost immediately stick their heads out again for observations. Instead of diving into the burrow they sometimes crouch low on their bellies and await further developments. When they do this they are relatively inconspicuous against the sandy background, which harmonizes well with their coat color.

When running slowly and normally from bush to bush the tail is carried over the back in the same manner as is characteristic of *Ammospermophilus*, but the white underside of the tail is not as conspicuous as it is in the latter animal. Neither do they twitch their tails as do the antelope squirrels. If slightly startled while feeding they rise upon their hind feet, picket-pin fashion, in order to gain a better view of the surrounding territory. When sitting in this position the front legs hang limply along the ventrolateral part of the body.

Burrows.—The burrows of these squirrels enter the ground at an angle of about 35 degrees. The dirt taken from the burrow apparently is scattered, for little or none is to be found at the entrance. A burrow system excavated

one-half mile east of Palmdale had two openings. One of these was nearly round, but the other was slightly oval. They measured 2 inches in the smaller and two and one-half inches in the greater diameter. The openings were 54 inches apart and the simple tunnel was 12 inches below the surface at the deepest point. Above the tunnel was an enlarged chamber, but there was no nest material. It is possible that the burrow as yet was incomplete, as a female did some digging near the entrance while I watched her. On April 12, I followed a female squirrel from 9:00 A.M. to 3:30 P.M. I remained at a sufficient distance to avoid startling her and she went about her business in an apparently normal way. During the six and one-half hours that she was under observation she entered 4 different burrow systems, remaining but a few minutes in each. The last burrow entered (entirely on her own volition) had been partially plugged and it was necessary for her to remove some loose earth from the entrance. As she entered the burrow she kicked back loose earth with her hind feet and partially plugged the hole from within. I watched the burrow for several minutes, but she did not emerge.

Foraging.—When foraging these squirrels move about slowly and cautiously among the vegetation, sampling a bit of food here and there. During early spring, at which time the present observations were made, the food is composed almost entirely of the tender green vegetation then just beginning growth. The following account is taken from my field notes of April 12. "Three miles east of Palmdale, at 9:00 A.M. I saw my first squirrel near a side road. She was feeding around a small patch of green vegetation, chiefly alfilaria, where she remained for 50 minutes. Apparently she was undisturbed by my presence in a car 15 feet away. While feeding she would crawl along among the vegetation, bite off a green stem or leaf, hold it in her front feet, and eat it while sitting half erect. She would then crawl a bit farther and repeat the process. Most of the time she was relatively inconspicuous. While searching for food in this manner her tail was almost constantly moving slowly from side to side. When she chose to sit up her tail was brought against her back. She fed almost continuously for the 50 minutes that I watched her. How long she had been feeding before I saw her I do not know. The only interruptions in her feeding were when she stopped to scratch herself or to investigate some strange noise. At 9:50 A.M. she started away, running slowly for short distances and stopping often to investigate the possibility of some plant for food. Ten minutes later she entered a burrow which was about 106 yards in a straight line from where first she was seen. She travelled really farther than that, as she took a rather zigzag course. After 10 minutes in the burrow she appeared again and began searching for food. Now she would sample only a bit here and there. She spent much of the time exploring and climbing over fallen trunks of a dead Joshua tree. Five or 6 times she was observed to climb into small bushes and to eat some of the green buds, but never did she ascend higher than a foot from the

ground. During this time (two and one-half hours) she covered an area within a radius of about 25 yards, and entered 3 more burrows. At 3:30 P.M. she was still out foraging. I had followed her for six and one-half hours. It was a warm clear day."

As I approached a squirrel on March 29, she dodged into a burrow, but emerged in about two minutes and started feeding on green vegetation. When she had worked about 20 feet away from the burrow I again approached her in order to see what she would do when her retreat was intercepted. The surprise was mine when she went into a burrow a few inches from where she was feeding. I had not seen this burrow before and it was not apparent from where I stood 15 feet away. Presently she emerged again, washed her fur, and renewed her feeding activities. During the 45 minutes while I watched this squirrel, her activities were confined to a small area not more than 10 yards in diameter. At no time was she more than 5 feet from a burrow entrance. One of the burrows entered by this squirrel had the general appearance of a kangaroo rat burrow. This individual was near a highway and whenever a car passed she crouched for a moment, but when the car had passed she immediately continued foraging. When the squirrel finally was caught her cheek pouches were filled with finely chewed green vegetation.

Sanitation.—On March 29, 1931, a squirrel was seen feeding near its burrow. At short intervals it stopped feeding and scratched various parts of its body. While I watched, it spent fully 5 minutes scratching itself and washing its fur. The latter act was accomplished in somewhat the same manner as is characteristic of a cat. After thoroughly washing its face and the underparts of its body it resumed its feeding on the tender green vegetation around its burrow.

Reproduction.—A female taken March 29, 1931, contained 6 embryos measuring from 31 to 36 mm. in length. Another female, taken April 12, was suckling young. Her uterus showed that she had but recently given birth to young ones.

Hearing.—Squirrels observed near a busy highway, where automobiles continually were passing, showed little or no reaction to the ordinary sounds of a passing car, but if a motorcycle passed or a horn was heard, immediately they reacted by twitching, and then cautiously looking in the direction of the sound.

Voice.—The call of this squirrel resembles a shrill whistle. It is a high pitched *peep*, with a slight rasping effect. It sounds very much like a similar note given by the horned lark, but is less smooth and liquid.

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NOCTURNAL EXPLORATIONS OF THE FOREST DEER-MOUSE

By W. H. Behney

Previous writers on the subject of the activity of deer-mice have stated that these animals are nocturnal (Sumner and Swarth, 1924; Johnson, 1926). Svihla (1932) made the additional statement that they "are particularly active during the early hours of the night." These assertions apply to activity in general and are not restricted to explorations outside the nest in search of food.

The primary aim of the investigation here described was to discover the periods of the daily cycle during which deer-mice (*Peromyscus leucopus noveboracensis*) are outside their nests. The apparatus here used was designed to record only the trips made by the animals to and from the nest.

In an attempt to imitate natural conditions as nearly as possible a combination nest and activity cage was constructed (fig. 1). This consisted of a nesting box (C) built in the form of a cube with inside measurements of 4 inches on a side. Holes one inch in diameter were bored through the top, to admit fresh air, and covered with one-quarter inch wire mesh. Cotton was supplied as nesting material. The nesting box communicated with the activity cage (A) by means of a wooden tunnel (B) 12 inches long by one and one-half inches wide and high. The activity cage measured 3 feet long by 10 inches wide and 8 inches high, and was covered with one-quarter inch wire mesh. The end of the cage opposite the nesting box was hinged to permit access to the inside of the cage. Water and food were placed in open dishes at the outer end of the cage. The food was the powdered form (Dice's formula, 1929) to prevent storing by the mice. Green food was supplied several times weekly.

A series of four sets of this activity apparatus was erected in an exposed location outdoors, and elevated about 6 inches from the ground. A box was built around the nesting boxes and tunnels which then were surrounded with hay, to insulate them.

Recording Apparatus.—The recording apparatus consisted of a lead-weighted wire door suspended in the tunnel two inches from the outside end. When the bottom of the door was pushed outward this caused a switch to slide over a contact plate, thus completing an electric circuit. Pushing the bottom of the door inward toward the nest completed another circuit. These circuits were connected to a recording instrument copied from the itograph described by Kendeigh and Baldwin (1930). A recording pen (P) resting on a strip of paper rotating on a drum (R), geared to a clock mechanism (E), makes a straight line on paper when the door is in a vertical position, but the movement of the door in one direction actuates a magnet (D) which pulls the pen to one side while the movement of the door in the opposite direction causes another magnet to divert the pen in the opposite direction. Wires

were run from the door switches to a set of four recording pens located indoors. A Weather Bureau field station was erected beside the activity cages. Continuous records were made of the temperature and relative humidity. It was hoped that with this apparatus it would be possible to obtain accurate information regarding the amount of time spent by the mice outdoors under various weather conditions. During the periods covered by this experiment, however, there appeared to be no correlation between activity and weather conditions as regards temperature and humidity, although the temperature varied from 45 to −20 degrees Fahrenheit.

Periods of Outdoor Activity.—One mouse was placed in each cage during the latter part of December, 1932. The specimens were trapped in deciduous woods at the northern limits of Burlington, Vermont. The tunnel door was fastened in an open position for several days in order to allow the animals to

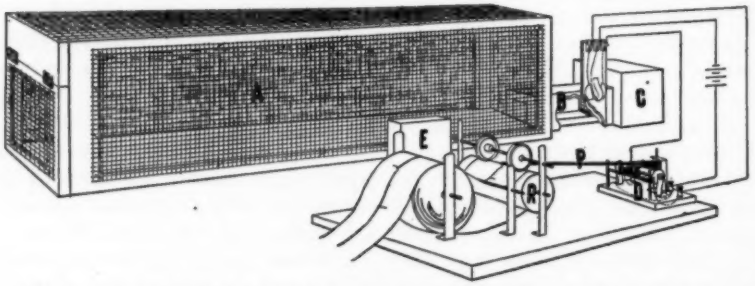

FIG. 1. Apparatus used in making records of explorations outside the nest. A, activity cage; B, tunnel; C, nesting box; D, magnets and armature; E, clock mechanism; P, extension of armature bearing recording pen; R, revolving drum which carries paper under pen. (Drawing by Marion Moody under Vermont Relief Administration project).

become accustomed to the runway. The door then was permitted to swing free. For the next few nights the mice spent a great deal of time playing with the door, but soon they became accustomed to the obstruction and merely pushed it out or in as they went through the tunnel. Records were kept of the trips through the tunnels during the month of February, 1933. The apparatus again was erected the following fall and records obtained from October 31 to December 24, 1933.

During the periods covered by the records the mice were in the outdoor cages at various times from one-half hour after sunset until about an hour before sunrise. The length of time spent outside at one trip varied from a few minutes to two hours. The upper portion of chart 1 indicates the duration of the outdoor trips of one individual over a period of one week, under what might be considered normal weather conditions. It will be noted that the outdoor trips were restricted to the periods between sunset and sunrise. The

records were continuous for the entire 24 hours of the day, but showed no daylight trips into the cages when these were bare of snow and the mice were supplied with plenty of food. Since the length of the period of darkness varied throughout the months of the investigation it seemed best to plot the combined records of activity against periods of time which represented equal fractions of the period of darkness, instead of actual clock hours. The total number of minutes between sunset and sunrise was determined for each night throughout the duration of the experiment. Each "night" was divided into 50 periods and the actual clock time for each fraction was determined. The records then were examined for evidences of outside activity during this time.

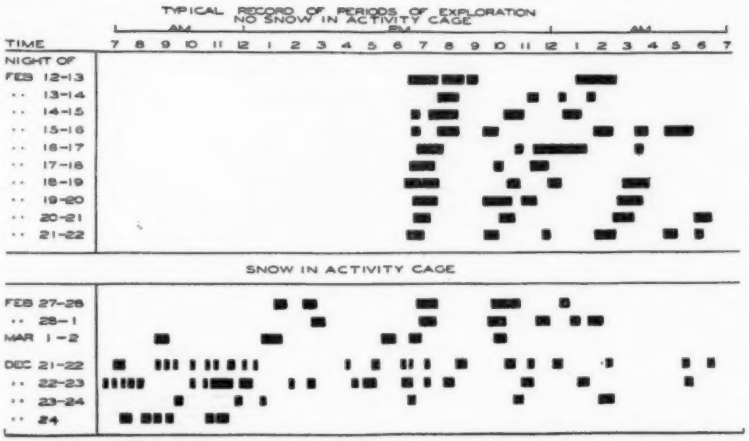

CHART 1. Graphic illustration of the periods of time during which the *Peromyscus* were active outside the nest. The black areas represent periods of activity.

All records for each fraction of the night then were plotted on chart 2. The result is a somewhat smoother curve than that which ensued when actual clock time was used. The chart shows that outside exploration begins shortly after sunset, and within a short time (approximately one hour) afterward reaches its peak. Thereafter there is a decline in the number of excursions, but activity continues, with somewhat reduced vigor, until the latter part of the night, when the number of activity records again increases slightly. The greatest activity occurs about one hour after sunset.

These periods of exploration agree, up to a certain point, with those for activity of the same race of deer-mouse obtained by Johnson (1926). Johnson's apparatus measured all activity of the mice whether in the nest or outside, whereas the present apparatus recorded only the explorations outside the nest. Johnson's records show that "the deer mice are active from

dark until daylight, and quiet from daylight to dark." His records show nearly continuous activity throughout that period, while the present records indicate varying degrees of activity outside the nest. Periods of night-time activity in the nest recorded by his apparatus, but not by ours, explain the differences obtained.

Diurnal Activity Outside the Nest.—Two conditions constituting exceptions to this general behavior should be considered. First, when the activity cage contained an accumulation of snow; and second, when there was a scarcity of food. For example, 6.5 inches of snow fell on February 25 and 26, 1933, some of which melted the following day, leaving 5.8 inches on the ground.

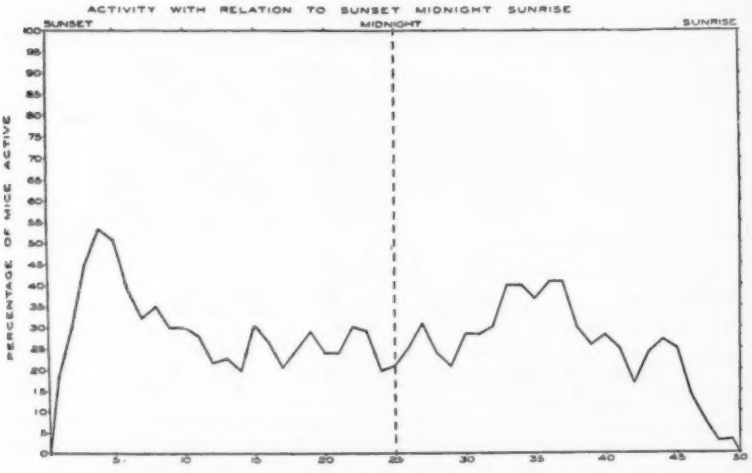

CHART 2. Graph showing percentage of mice active at each of fifty equal periods of the night.

Three inches additional fell on February 28, making a total of 8.5 inches of snow. The records for February 25 and 26 were typically nocturnal. Examination of the cages on the next morning disclosed that the snow was well tunnelled. The records for February 27 and 28, and for March 1, show daytime explorations, on the first two days in the early afternoon, and on the third from mid-morning throughout the day. This exception to the usual activity period of the mice is shown by the lower portion of chart 1. Normal nocturnal activity was resumed as soon as the snow melted. A similar incident also is shown on the same chart for the period covering December 21 to 24. At this time the mice were active in their tunnels within those cages containing from 6 to 7 inches of snow.

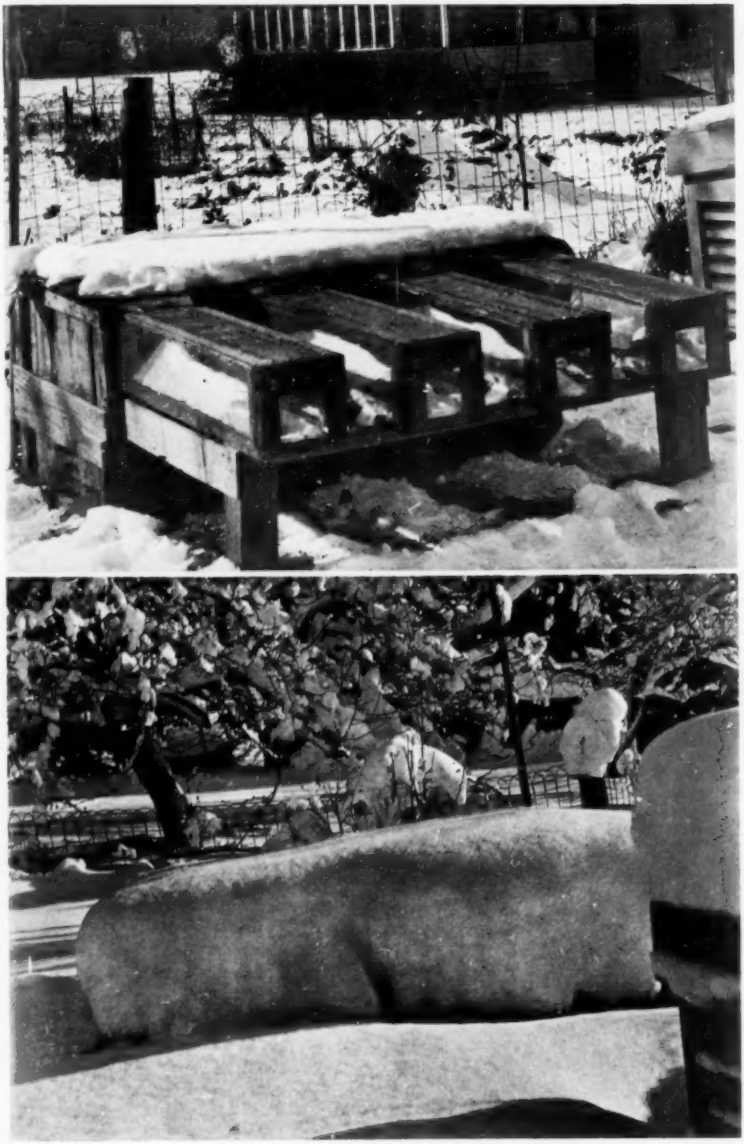

FIG. 2. The activity apparatus used in the present investigations, showing external details above, and after a heavy snowfall below.

The second exception to strictly nocturnal activity outside the nest occurred during March after records no longer were being taken. By an oversight, one of the cages was not supplied with food for several days, when the inmate attracted attention by operating the tunnel door at noon. When food was placed in the cage it came out at once and proceeded to satisfy its hunger, even though it had to sit in bright sunshine to do so. It then proceeded to transport the food, which in this case was commercial rabbit food in the form of one-quarter inch pellets, through the tunnel into the nest. It continued to carry away the food until it had emptied a tumbler full.

A trip was made on the average of once every 30 seconds.

These two exceptions show that deer-mice may vary the usually fairly constant nocturnal period of activity because of the physiological urge of hunger, or when protected by a blanket of snow.

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OBSERVATIONS ON THE SEASONAL AND REPRODUCTIVE ACTIVITIES OF THE EASTERN CHIPMUNK

By John M. Condrin

During the past four years more than 200 specimens of the eastern chipmunk have been taken in the vicinity of Fort Meigs, near Perrysburg, Ohio. Comparison with series of both *Tamias striatus fisheri* and *Tamias striatus lysteri*, made by A. H. Howell, indicates that the animals used in this study are referable to *Tamias striatus lysteri* (Richardson). Various investigations on these animals have been made by the author, but they were collected primarily for the purpose of studying their hibernation with particular reference to the rôle played by the various endocrines. In the course of this study, however, many interesting details of their habits and seasonal activities were observed, some of which apparently have not been recorded previously. Only a few specimens of this subspecies have been taken in Ohio (Howell, 1929), and none in northwestern Ohio (Wood County), so it seems desirable that these observations be recorded.

Most of the specimens were obtained from a cemetery at the edge of Perrysburg, and from the side of an adjacent ravine. Trapping was more productive in the cemetery as the chipmunks sought shelter under tombstones. A spring-floor rat trap was set at one of the several openings at the edge of the stone, and the other openings were closed. In most cases the rattling of a stick under the tombstone was sufficient to cause the animal to enter the trap. Some specimens were obtained from traps set at the burrows in the side of the ravine. The latter method took longer and seldom was employed, as often it was necessary to wait for some time before the animal left the burrow.

Appearance in the spring and disappearance in the fall.—The time at which chipmunks emerge in the spring is somewhat variable, but according to our observations the first animals appear during the last week in February or the first two weeks in March. In 1932, the first animal seen was reported by the caretaker of the cemetery on March 6. Within a week many more were seen, and the first chipmunk was taken on March 18. In 1933, the first individual was observed February 27. A period of bad weather immediately followed and no animals were taken thereafter until the latter part of March. In 1934, the first individual was seen on March 1, and in 1935, on March 3. The males usually are the first to appear, and are followed several weeks later by the females.

The time of permanent retirement for the winter also varies somewhat, and depends upon the weather. The latest date of capture was November 3, 1933. On warm days, however, chipmunks have been seen as late as the last week in November, and one individual on November 27, 1933. Many are active throughout October. These dates agree in general with those given by Seton (1909), Reed and Wright (1909), and Evermann and Clark (1911) for different regions of the northeastern United States.

Reproductive activities.—The mating period appears to have no definite limitation, although many animals mate during March, probably the first part of April, and again late in June, for most of the young are born in May and August. Young have been

observed throughout the spring and summer, however, and as late as October. Pregnant females have been taken as early as March and as late as October. The distribution, by months, of pregnancies observed, and the number of young taken in the field, are shown in the graph.

A number of males kept in the laboratory throughout the winter months became sexually active about the middle of February, as was observed in different groups of males for two years in succession. This seems to indicate that the males, at least, are ready for mating before they emerge from their burrows in the spring. That mating does occur perhaps as early as February is attested by the fact that a pregnant female was taken March 12, 1933, and one female kept in the laboratory all winter was ready to breed on February 27. It is possible, however, that laboratory animals may become

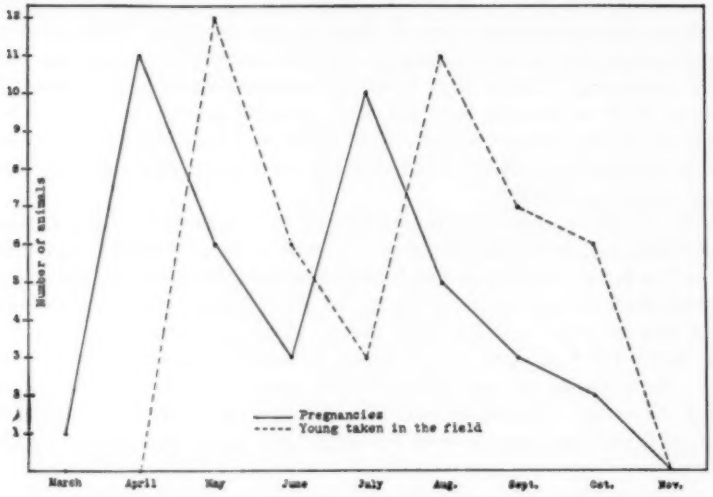

FIG. 1. DISTRIBUTION, BY MONTHS, OF PREGNANCIES AND OF YOUNG TAKEN IN THE FIELD

sexually active much earlier than animals in the field. This was observed by Johnson, Foster and Coco (1933) in the case of the thirteen-lined ground squirrel.

Numerous attempts to breed these animals in the laboratory have been unsuccessful. Most of the known methods of stimulating reproductive activity were employed, and lengthy observations were made to determine whether coitus followed such treatment. Sexually active males and females were mated and observed for 10-hour periods, but in no instance was copulation seen. Untreated animals that were reproductively active appeared to be quite irritable and quarrelsome, and invariably, if left together in the same cage for any length of time, one was killed. This was found also to be generally true in the case of animals not sexually active; hence all animals required separate quarters.

Careful studies of laboratory animals revealed no organic basis for this incompatibility, and apparently the nervous state accompanying captivity is the chief cause of sterility, as is true of other wild animals. Similar studies made with the thirteen-lined ground squirrel (Johnson and Wade, 1931) point to the same conclusion.

Some interesting data were recorded on the number and the uterine position of embryos. The nodes containing embryos, or post-parturitional scars, were counted in all females that died in the laboratory or on which operations were performed. These results are shown in table 1. The average number of embryos was 5.02. This figure is somewhat higher than the estimates given by various investigators. Jennison (1927), for instance, gave the number of young as 3 to 4. The present slightly higher figure may in part be due to the fact that others have counted the number of young surviving after birth, rather than in utero. It is possible that there is a certain mortality among the developing embryos because of deficiency in nutrition and similar causes. Only three litters were delivered in the laboratory, numbering respectively 3, 4, and 6. All of these females were late pregnancies when taken in the field, and were delivered at periods varying from 3 to 13 days after capture.

Every precaution was taken to insure the survival of the young born in the laboratory, but in each case the mother discarded the young, one at a time, from the nest, and refused to care for them. This occurred despite the fact that the mothers were fed a well balanced diet rich in proteins and containing all necessary vitamins. By the end

TABLE 1

Number and distribution of embryos in 41 pregnant uteri of Tamias striatus lysteri

NO. OF ANIMALS WITH STATED NOS. OF EMBRYOS IN	NO. OF EMBRYOS								AVERAGE NO. OF EMBRYOS
	0	1	2	3	4	5	6	7	
Right horn of uterus....	1	3	11	14	6	3	0	0	2.79
Left horn of uterus.....	1	0	26	11	0	0	0	0	2.23
Entire uterus*.....	0	0	2	2	8	15	11	3	5.02

* These totals include three litters that were delivered in the laboratory and for which it was impossible to determine the distribution in the two horns.

of the tenth day after birth the young were dead. No attempt to eat the young was made by any of the mothers, and only one showed any signs of injury, this being a small piece of skin torn from the lateral surface of the neck.

Evidence of resorption of embryos by pregnant females in the laboratory was secured in the case of four animals. Autopsy revealed that all embryos in these females were being resorbed. One of the cases represented a late pregnancy. This, apparently, is a physiological effect of captivity and may account for the small number of litters actually born in the laboratory.

Hibernation.—Howell (1929), in summarizing what is known about hibernation in chipmunks, emphasized the apparent disagreement among observers as to whether hibernation actually occurs, or whether the animals remain more or less active during the winter. He cited a number of instances where dormant animals were observed or taken in the field, as well as numerous records of fully active or only slightly inactive animals.

My observations, both on laboratory and field animals, indicate that generally the eastern chipmunk is not a deep hibernator, but that very definitely it must be classed as a hibernating form. Animals in varying states of torpidity have been taken from their burrows; and all degrees of inactivity from slight inanition to very deep lethargy have been noted on different occasions in laboratory animals. On the other hand, many animals kept at room temperature remain fully active throughout the winter.

Temperature and confinement are the most important predisposing factors in deter-

mining the degree of activity during the winter months, although it was found that certain animals exposed to low temperatures, or in confinement, or both, remained wholly active, while others under similar conditions became inactive or completely torpid.

Since this study was undertaken with the primary purpose of ascertaining what part, if any, the various endocrine glands may play in hibernation, these glands were examined. A much more detailed account of this phase of the work will be reported in a later paper. Suffice it to say, here, that a careful study of the various glands, particularly the pituitary and adrenals, indicated very definite individual differences. Pronounced seasonal variations in the endocrine system likewise have been detected, explaining in large measure the variation in winter torpidity. Individuals with stable and fully functioning endocrines are able to remain active under adverse conditions, while those unstable in this respect succumb easily and enter a semi-torpid or torpid physiological state. In general the animals studied are more unstable during the winter months, some of the glands being definitely deficient at this time of year.

This instability is manifested by reduction in body temperature and particularly in general metabolism, which in turn is accompanied by such physiological phenomena as fall in blood sugar, reduced blood count, increased viscosity of the blood, and similar physiological changes. None of these manifestations are new to the student of hibernation. Their correlation with specific endocrine changes, which not only vary in different individuals but also show definite seasonal trends, is very significant, however, and the exact nature of these findings is withheld pending completion of further experimental data.

This work was undertaken at the suggestion of Dr. A. E. Woodward, University of Michigan. I wish to thank Dr. Woodward for her suggestions, and E. R. Uthoff of Perrysburg for his generous assistance in the collecting of specimens. This paper is a contribution from the Department of Zoology, University of Michigan, and the Department of Biology, University of Toledo.

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BAT BANDING

By Donald R. Griffin

Bats always have had a particular appeal to many naturalists, and this appeal is greatly enhanced for most of us by the lack of definite knowledge concerning their habits. The example set by bird banding has led several mammalogists to try marking studies with bats to investigate their movements and migrations. In a previous paper (1934) the early work and general methods of bat banding have been summarized, but since then, the banding work has reached much larger proportions. Bats have been banded both in summer colonies on Cape Cod, Massachusetts, and in caves in Vermont. To date about 3000 bats of 6 species have been banded, and over 700 recoveries of marked bats have been recorded.

This paper is intended to outline some of the more important features of these investigations and to submit a request to mammalogists for cooperation in recovering banded bats. It is impossible to acknowledge at this time all the assistance which has been received in the course of this work, but I do wish to express my gratitude to F. L. Osgood of Rutland, Vermont, for without his store of local knowledge and his invaluable and untiring cooperation at all times, these investigations never could have been conducted.

Table 1 shows the number of bats banded in various regions during the four years that this work has been in progress, and the numbers of each species banded.

Three principal objectives were in mind in undertaking the bat banding: (1) To determine whether the same individuals return annually to the summer roosts from which they are absent in winter, and likewise to determine whether the same bats return in successive winters to the caves where they hibernate; (2) to ascertain whether bats released at a distance from their summer roost will return to it; that is, whether they have a homing instinct; (3) if possible to trace the movements of individuals by recoveries of marked bats.

The results of these marking studies, together with those of other workers in this field, have yielded interesting data on the first two points. To date, however, the recovery of marked individuals has shed no very significant light on the exact migration routes of American bats. It is much more difficult to obtain returns from banded bats than is the case with birds, chiefly because of the lack of popular interest in bats and because of their retiring habits.

Banding studies conducted in Germany by Eisentraut (1934, 1935, 1936), however, have furnished much information on the migrations of European bats. During the winters from 1932 to 1935, Eisentraut banded 5820 hibernating *Myotis myotis* in caves near Berlin. During the succeeding summers, 102 of these bats were retaken away from the caves. Most of these recoveries were within 50 miles of the winter quarters, although one was recaptured at a distance of 100 miles. Practically all of these bats were recaptured at points

to the north and east of their hibernating quarters, indicating that the general drift of their migration was in these directions.

An average of about 32 per cent of the bats banded in the caves were recaptured the following winters, mostly in the same parts of the same caves where originally they were banded. In cases where a very thorough check on the bats was possible, Eisentraut found that as many as 50 per cent of the bats returned the next winter to the caves where they were banded. In one particularly interesting experiment, a group of 20 bats were transferred from one cave to another. The next winter 5 of these bats were retaken, and all 5 were in the cave where originally they had been captured. In another experiment 22 *Myotis myotis* were sent from these caves near Berlin to the vicinity of Dresden, 90 miles to the south. The following winter one of these was recaptured in the same part of the same cave where it first had been caught. These recoveries surely indicate a strong homing instinct.

TABLE 1

Summary of bats banded

REGION & YEAR	*Myotis l. lucifugus*	*Myotis sodalis*	*Myotis k. septentrionalis*	*Myotis subulatus leibii*	*Pipistrellus subflavus*	*Eptesicus f. fuscus*	TOTAL
Cape Cod, 1932	28	—	—	—	—	—	28
Cape Cod, 1933	129	—	—	—	—	—	129
Cape Cod, 1934	525	—	—	—	—	—	525
Cape Cod, 1935	273	—	—	—	—	—	273
Vermont, 1934–35	178	631	4	—	3	—	816
Vermont, 1935–36	404	697	17	2	23	—	1,143
Miscellaneous, 1935–36	25	1	5	—	15	28	74
Totals	1,562	1,329	26	2	41	28	2,988

Conclusive evidence of a more spectacular migration is supplied by the returns from 600 noctules, *Nyctalus noctula*, that were banded in Dresden during the winter of 1934–1935. The noctule is a large bat and a strong flier, and is somewhat like the American hoary bat, *Lasiurus cinereus*, in general form. Four of these noctules later were recaptured. One was found near Hanover, about 175 miles northwest of Dresden, and the others were retaken at points in Poland and Lithuania, at distances of about 190, 350, and 475 miles from the place of banding.

These results obtained by Dr. Eisentraut from the banding of about 6500 bats certainly show that these two European species perform considerable migrations, and indicate what can be accomplished in this field by cooperative work.

C. E. Mohr (1934, and Poole, 1932) has banded about 200 bats in Pennsylvania, and has conducted some very interesting homing experiments. In

several cases bats released as far away as 30 miles returned in a few days to their home roosts.

H. B. Sherman (personal communication) banded 76 young *Tadarida cynocephala* near Gainesville, Florida, and one later was recovered 15 miles away.

Methods of Marking.—The majority of the bats that I have marked were banded on the hind leg with no. 0 aluminum bird bands such as are issued by the U. S. Biological Survey. In fact the bands used were surplus bird bands marked on the inside "Notify Biol. Surv. Wash. D. C." They were purchased from the manufacturer with the permission of the Survey. The bands are almost completely closed around the bat's hind leg on the ventral side of the membrane. The membrane is not cut, but the band is closed tightly so that it cannot come off. There is an excellent photograph of a banded pipistrelle in A. A. Allen's paper (1921) showing this method of applying the band. Among all the banded bats recaptured after intervals of as much as two years, I never have found a band that had become at all illegible.

Some workers have used different marking methods, for in some cases the larger species chew the bands so as to render them illegible. Eisentraut placed regular aluminum bird bands around the bat's forearm in exactly the same manner as described above for leg banding. Mohr (1934) has experimented with various methods, from histological stains to metal ear tags (fingerling tags), and he came to the conclusion that the latter method was the most suitable. During the past year, the writer has marked a few bats with wing bands and ear tags, but there seems to be little to choose between the three principal methods of marking: leg bands, wing bands, and ear tags.

Recoveries.—The recoveries of banded *Myotis l. lucifugus* at two caves, at Plymouth and Chittenden, Vermont, are of some interest. They were visited several times and most of the bats present were captured. During the winter of 1934–1935, there were banded in these caves 606 bats of four species (see table), and 224, or about 37 per cent, were recaptured in the same caves during the following winter. Although they are only 10 miles apart, there was detected no shift of bats from one cave to the other. At the Plymouth cave, where the colony was smaller and the bats easier to catch, recovery of banded individuals was 47 per cent; at the Chittenden cave it was 35 per cent. Eisentraut found that about this same percentage of his banded *Myotis myotis* returned the second winter to the caves where they were banded.

These percentages of recoveries seem sufficiently large to indicate that most of the bats hibernating in these caves return for successive winters. The natural mortality of adults and their replacement by young tends to reduce the number of banded bats recaptured. Also many bats escape capture at each visit.

At the summer colonies on Cape Cod, an average of about 11.5 per cent

of the *Myotis* banded were recaptured in subsequent seasons. This percentage is rather low, and may indicate that the bats do not have as strong a tendency to return to the same summer roosts. At the summer colonies, however, it is much more difficult to catch bats, and many of them invariably escape, with consequent reduction of the percentage recaptured.

Homing experiments have been continued in the Cape Cod region with *Myotis l. lucifugus*, and have yielded several records of bats that returned to their home roosts when released at a distance. The most interesting of these cases is that of a bat released at sea. This bat was one of a group of 25 liberated by B. Leavett, of the Woods Hole Oceanographic Institute, from the ship *Atlantis* as she left Woods Hole. They were released in groups of five at intervals of one hour as the ship left Vineyard Sound. The last bats were liberated 12 miles SSE of No Mans Land Island (near Marthas Vineyard). The only subsequent recovery was one of the members of the last group liberated. It returned 36 miles to its home roost, and at least 12 miles of this distance was over open water. Surely this indicates that even the smaller bats are capable of the sustained flight necessary for migrations.

In other homing experiments bats returned 5 to 34 miles to their home roosts. Several other returns were secured from banded bats, both on Cape Cod and in Vermont, which make it possible to trace the movements of individuals.

Banding studies have established longevity records for three species of bats as follows: *Myotis l. lucifugus*, 4 years; *Pipistrellus*, 4 years (Allen, 1921); *Eptesicus f. fuscus*, 3 years (Howell and Little, 1924).

In reviewing the efforts that have been made to study bats by the marking method, one point especially is noticeable. To date all bat banding in the United States has been confined to the species that are easy to catch, while those known to perform long migrations have not been banded. The red, hoary, and silvery-haired bats (*Lasiurus borealis*, *Lasiurus cinereus*, *Lasionycteris noctivagans*) are known by circumstantial evidence to be migratory (Miller, 1897; Merriam, 1887; Allen, 1923), but they are not gregarious and therefore are difficult to capture in quantities.

Discussion and Conclusions.—The rather meager data obtained from these banding studies at least demonstrate the fascinating possibilities for future investigators in this field. The following conclusions can be stated with some assurance:

(1). A total of about 9500 to 10,000 bats have been banded to date by various workers in the United States and Germany, and several hundred recaptures of banded bats have been recorded. These results show conclusively that bat banding is entirely practicable, and that highly interesting information on the movements and migrations of bats can be secured by these methods.

(2). Marking studies have shown that bats generally return annually to

the same caves to hibernate; there is also probably some tendency for the bats to return in successive summers to the same summer roosts.

(3). Several species of *Myotis* have been shown to possess a strong homing instinct, and even these smaller species are capable of the long flights necessary for migrations.

Although Eisentraut's banding studies in Germany have demonstrated the direction and extent of the migration of two European species, very few banded bats have been recaptured in the United States at a distance from where they were banded. Presumably many of the breeding females congregate in summer colonies in the northeastern states. All naturalists in this region are requested to watch for banded bats, and to communicate full data to the Biological Survey or to me. If the bat has been killed the band should be removed and returned, together with complete data on the date and place of recovery; otherwise the number should be noted carefully and the bat released.

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SEASONAL FOOD OF SKUNKS IN NEW YORK

By W. J. Hamilton, Jr.

The food of New York fur-bearers has been studied by the writer during the past 9 years. Commencing in 1927, viscera of these animals were collected from trappers and fur buyers, while feces were secured and examined as opportunity permitted. Numbers of skunks found dead on the highways also were examined. About 3000 analyses have been made, more than half of which pertained to the eastern skunk (*Mephitis nigra*).

Owing to the widespread abundance of the striped skunk, its value as a fur-bearer and its reputed damage to game, poultry, and bees, the feeding habits of this animal have been studied by numerous investigators. Previous papers include those of Lintner (1888), Pellett (1913), Lantz (1914), Criddle (1914), Davis (1919), Dixon (1925), Shaw (1928), Hamilton (1929, 1931, 1935), and Dearborn (1932). All appear to be essentially in agreement in finding the skunk an asset to any farm community.

Among more than 50 contributors, especial thanks are due to Clark Breed, E. E. Brown, David B. Cook, and Floyd Snyder for supplying me with many skunk carcasses and feces.

For the fall and winter records (October–March) about 1500 viscera were examined. Frequently a trapped skunk had eaten nothing but dirt and parts of the trap stake, together with its own claws, flesh, and fur, which had been ingested in its struggles to escape. Animals trapped after a prolonged spell in dens invariably had empty stomachs. Accordingly, only 1067 animals contained sufficient food to rate a satisfactory determination. Spring and summer records (April–September) include about 570 fecal and 30 stomach analyses. Roundworms (*Physaloptera maxillaris*) were found in 96 per cent of the stomachs examined.

FALL AND WINTER FOOD

Table 1 gives the fall and winter food of 1067 skunks, indicating the proportions and apparent importance of the various items eaten. Availability apparently determines the nature of the food. A few typical stomach contents are listed to indicate the wide choice of food exhibited by skunks. During a warm night in mid-November, 5 skunks were shot by hunters and the stomachs given to me. One had eaten the remains of a schoolboy's lunch, another part of a water snake, a toad, several cutworms, pigeon grapes, dry grass, and a few chips of wood, while a third had eaten half a pint of grasshoppers and crickets. Still another had eaten a small piece of an inner tube, while a fifth had dined freely on the fallen fruit of wild cherry and also several tipulid larvae.

Fruit.—Fruit is the most important food, both in number of times taken and amount eaten. Practically a third of the animals contained this item. Apple was found in 139 skunks, occurring in 13 per cent of all fall and winter animals. Wild grapes and Virginia creeper berries were eaten by 106 skunks, wild cherries by 71 individuals, the fruit of horse nettle (*Solanum carolinense*) was taken by 24 animals, and ground cherry (*Physalis*) occurred 17 times. A few had eaten partridge berries, nanny berries (*Viburnum lentago*), various species of *Cornus*, and miscellaneous drupes.

Mammals.—Slightly less than a fourth (22.5 per cent) of the skunks contained mammals. Of the 240 with mammalian remains, 103 had eaten *Microtus*, which were found in 9.57 per cent of all fall and winter stomachs. On 4 occasions, 3 meadow mice were found in a single stomach. Rabbits had been eaten by 44 skunks, or 4.1 per cent of the winter total. It is difficult to ascertain whether this last element represents a natural catch on the part of the skunk, or bait used by the trapper. Certainly some portion represented carrion. I know, however, that upon occasion skunks do overcome cottontails. On March 14, 1931, while hunting rabbits near Ithaca, New York, with Robert Rightmyer, we heard the prolonged squealing of a cottontail. Upon reaching the scene, we found a skunk backed into a hole and securely grasping a dying rabbit, which was torn from the skunk with some effort. *Peromyscus* occurred in 17 individuals, or 1.6 per cent of the skunks examined. Shrews (10 *Blarina*, 1 *Cryptotis*) had been eaten by 1.03 per cent, and rats (*Rattus*) by .84 per cent of all the skunks. Seven skunks had eaten

TABLE 1

FALL AND WINTER FOOD OF 1067 SKUNKS FROM NEW YORK

(*October to March, 1927 to 1934*)

FOOD	INSTANCES	PERCENTAGE BY BULK IN ALL STOMACHS
Fruit	341	26.7
Mammals	261	19.6
Insects	276	6.8
Grasses, leaves, buds	228	10.8
Carrion	152	13.5
Grains, nuts	123	11.3
Garbage	48	6.8
Earthworms	43	0.9
Birds	24	1.9
Reptiles, amphibians	21	1.4
Crustaceans	7	0.3
Mollusks	5	trace

red squirrels, but again it is problematical whether the squirrels had been used for bait or were caught by the skunk. Inasmuch as red squirrels frequently enter rabbit holes, it is obvious that some may have been captured by skunks invading such retreats. Other mammals eaten by skunks were *Tamias* (4), *Condylura* (3), *Mus* (2), *Napaeozapus* (1), *Clethrionomys* (1), and *Glaucomys* (1).

Insects.—Insect remains occurred in one-fourth of the fall and winter material examined; they were eaten largely prior to severe freezes, although grasshoppers were consumed throughout the winter. The rare warm spells of winter sometimes occasion a thaw. At and during these periods lepidopterous larvae, beetles and Orthoptera are caught. More than 60 per cent of all the insects eaten by skunks during this period consisted of grasshoppers (chiefly *Melanoplus femur-rubrum*) and crickets (*Gryllus assimilis*). An occasional Carolina locust (*Dissosteira carolina*) was taken by a skunk. Orthoptera are among the most important food items of the skunk during October. Beetles (principally carabids, wireworms, and the larvae of borers) occurred in 48 stomachs and comprised 19.1 per cent of the bulk of all insects that were eaten. The alfalfa snout weevil (*Brachyrhinus ligustici*) threatens the existence of the rich alfalfa belt of northern New York, and the skunk is the most persistent vertebrate enemy of this pest.

Skunk feces from weevil infested fields show great numbers of the larval head capsules of this beetle. One scat, hardly an inch long, contained the remains of 69 grubs. Another, taken in mid-November, contained in excess of 100 larvae. The skunks dig to a depth of from 2 to 4 inches in search of these grubs. Cutworms were present in 38 stomachs, comprising 19.7 per cent of the bulk. Hemiptera were found in 16 animals and formed 2.6 per cent of the bulk of all insects ingested.

Bees occurred in 6 of the 15 skunks that had eaten Hymenoptera. Apiarists have charged the skunk with much mischief, asserting that entire hives are destroyed by the activities of this animal. While the present investigation does not indicate widespread damage from this source, serious losses do occur upon occasion. The 6 bee-eaters all were caught during late November. They comprise only .56 per cent of the 1067 skunks examined, and they had eaten a total of 312 bees, all of which may have been dead when consumed. Bees are active during warm spells of the late fall. A sudden change in temperature frequently numbs the bees as they return to the hive, and as a consequence, large numbers often are found about the hive entrances. This may be the exception rather than the rule, but frequently, during the early winter, I have seen large numbers of dead bees about the hive entrances of poorly managed apiaries. Skunk injury to bees recently has been pointed out by Storer and Vansell (1935), who suggest fencing to minimize the damage. The cost of fencing in New York would be prohibitive. The practice of moving the hives sometimes 3 or 4 times in a season, and placing individual hives in strategic positions, as in orchards, would make fencing impracticable. Claw marks of skunks on the front of a hive indicate the presence of a bee-eater. As in the west, skunks will resort nightly to the same hive until the brood is destroyed completely. The bees that are not eaten frequently lose their sting, and as a consequence soon die. The only practical remedy is trapping the skunk before severe damage has resulted. If the owner be apprised of the damage early it is not difficult to control the animals with steel traps. Skunks destroy large numbers of deer-mice, which in turn frequently take up winter quarters in the hives, eating the comb and at times destroying the bees.

A few ants were found in 2 stomachs, yellow-jackets in 1, while what appeared to be sawfly larvae were found sparingly in a third. Diptera were represented chiefly by maggots of blow-flies, the skunks readily finding these when feeding upon carrion. The larvae of crane flies (Tipulidae) are procured well into the winter. Millipeds and centipeds are grouped with insects for convenience. They occurred in 1.68 per cent of the stomachs but constituted only a trace of the food.

Grasses, Buds and Leaves.—These items were found in 21.3 per cent of the animals examined, and totalled 10.8 per cent of the volume of all food. Upon the approach of severe weather other food becomes scarce, and the leaves of *Ranunculus*, *Trifolium*, *Solanum*, and various mosses are eaten. Rose hips were taken by one individual. On rare occasions a skunk will eat large numbers of the terminal buds of low growing shrubs or trees. As in the case of the red fox, green grasses, such as winter wheat, form an important addition to the winter diet, and are taken individually in sufficient quantity to refute the theory of self-medication.

Carrion.—It is difficult fully to decide what the skunk finds as carrion and what it captures as legitimate prey. Probably 80 per cent of the trapped animals are taken in den sets, where bait seldom is used. When bait sets are employed, rabbit is a favorite lure; yet we know that the skunk is capable of catching cottontails when these animals enter a den harboring *Mephitis*. During the winter months, dead poultry is thrown with manure into the fields and when found by a skunk is eaten with avidity. Dead horses, cows, and sheep attract skunks, and a large carcass acts as a lure to many animals, which take up residence close to such a commissary.

Grains and Nuts.—Corn, buckwheat, and other grains that have escaped the harvest, are eaten. Individuals have been known to consume horse manure for the undigested

oats it contains. Beechnuts apparently are seldom eaten, only one animal having this material in its stomach.

Garbage.—The frequent appearance during late fall of skunks about villages may be attributed in part to the ever-present supply of garbage, furnishing a wide assortment of food. Repeatedly I have found, in weighing skunks, that individuals taken in towns are consistently heavier than those from farming country. I attribute this to the abundance of food (garbage) in towns.

Earthworms.—Worms were eaten by 4.03 per cent of the animals. During the rare periods of mid-winter rains and thaws, worms are active and are easy prey for skunks. It is not unusual to find in a single stomach a handful of nightcrawlers, bitten through in several places.

Birds.—Birds occurred in 2.25 per cent of the stomachs. Small species (3 starlings, 2 song sparrows, 1 downy woodpecker, 1 bluejay, 1 house sparrow, and several undetermined fringillids) were eaten by 13 animals. Crows had been eaten by 7 individuals, but these probably were killed by hunters and later found by the skunks. Cock pheasants were eaten by 4 animals. These were taken directly after the trapping season opened (November 10) and well may have been wounded birds that had escaped the hunter. Apparently the remains of one had been taken from a garbage pile.

TABLE 2

SPRING AND SUMMER FOOD OF THE SKUNK

(*570 fecal and 30 stomach analyses*)

FOOD	INSTANCES	FREQUENCY PERCENTAGE
Insects	347	43.06
Fruits	221	27.56
Mammals	131	16.25
Grains	70	8.69
Carrion	17	1.76
Birds	11	1.46
Reptiles, amphibians	9	1.14

Reptiles and amphibians.—Of 13 skunks that had eaten reptiles, 7 contained remains of garter snakes, 3 held water snakes, and 1 had captured a small milk snake. Eight animals had dined upon Amphibia. *Rana pipiens* and *Bufo americanus* each had been eaten 3 times, while a small *Plethodon* and a large spotted salamander, *Ambystoma maculatum* (in February) constituted the remainder.

Crustaceans.—Sowbugs frequently are eaten, but their ingestion may be fortuitous, as when skunks are digging for grubs in and about punky logs. Crayfish were eaten twice.

Mollusks.—Snails (*Polygyra*) were eaten by 2 animals.

SPRING AND SUMMER FOOD

The period from mid-April to late September is represented by fecal analyses. Feces readily are obtained about skunk dens, along *Prunus* hedgerows, in open ground in orchards, and along pathways bordering woods. The ideal situation in which to find droppings is in blackberry thickets during late August and September. While an unduly large proportion of berry remains appear in the droppings at this season, enough food items of other sorts are encountered to make a fair analysis. Thirty dead animals found on the highways were examined.

During the early spring, when berries, fruits and insects are scarce, field mice form a major share of the food. Skunks dig through clumps of fallen weeds and hay with great industry, and burrow to a depth of a foot to capture the mice. With the advent of warmer weather and increasing activity of insects, attention is turned to the latter easily-procured food. By June almost every scat contains some insect remains. These constitute the major food-item of mid-summer until raspberries are available. From then until early fall wild cherries and other berries, together with grasshoppers and crickets, serve to prepare the skunks for winter.

Table 2 indicates the food of skunks in New York during the warmer months. The specimens came from widely different areas, the greater number having been collected in west-central New York. The Hudson Valley is represented by a goodly share, while some feces from the Adirondack and Catskill regions also were studied.

Fecal analysis does not offer as complete a picture of an animal's food as does stomach analysis, for in the former the undigested residue alone is present. If a skunk should acquire the egg eating habit, and not ingest fragments of the shell, no indication of this trait would be available in the feces. An undue proportion of a certain food indubitably occurs (as chitin of insects and stones from fleshy drupes), while earthworms and flesh, such as offal, do not register in the scats. Furthermore, particularly resistant stuff, such as the calamus of feathers, usually is slow to pass through the gut, and thus may occur in the droppings throughout several days, although representing but part of a single meal.

The contents of the 30 summer stomachs were much the same as in the 570 droppings. I feel convinced that the data thus are representative and may be taken as a general index to the spring and summer food of the skunk in New York.

DISCUSSION OF SPRING AND SUMMER FOOD

Insects.—Exact identifications of the various insect remains often were not possible. Sufficient determinations were made, however, to evaluate the general percentages of the various orders. The head capsules of larvae, fragments of wings and legs, offer a good clue to the forms eaten. Orthoptera are eaten in greatest numbers, but during early summer Coleoptera rival these in number. The skunk's most valid claim to protection, other than its fur value, is in the enormous number of white grubs (*Lachnosterna*) eaten.

Fruits.—Fruits constitute the most important fall and winter food, and during the spring and summer are second only to insects. Perhaps the most important of these are the fruits of various wild *Prunus*, yet wild raspberries, blackberries, and currants form a very prominent share of the mid-summer food. Strawberries are eaten avidly, and feces collected in late June carry abundant evidence of *Fragaria*. Skunks frequent the swamps for blueberries and grow fat on this fruit. In the Adirondack region, the animals resort to the berries of wild sarsaparilla (*Aralia*) and service berries (*Amelanchier*). Apples are eaten extensively in late summer. The fruits of dogwood and viburnum are taken less frequently.

Mammals.—Among mammal remains positively identified were *Microtus*, *Peromyscus*, *Blarina*, *Tamias*, *Sylvilagus*, *Rattus*, *Condylura*, *Zapus*, *Sciurus hudsonicus*, and *Cryptotis*. They are given in the order of their apparent frequency in the feces and stomachs examined. Meadow mice comprise more than 80 per cent of all mammals taken, and they appear to be the chief food of the skunk during April and May. In the 100-acre Cornell University orchard, during the springs of 1933 and 1934, there were estimated to have been approximately 8 or 10 skunks. During these years there was unusual opportunity to study mouse predation by the skunk. In a young orchard of 20 acres the trees were heavily mulched with hay. Under this cover the mice nested in consid-

erable numbers. Skunks, either by a keen sense of smell or by hearing, routed out more than 70 nests in one night. Seldom did an evening pass but that 20 or 30 nests were destroyed and the occupants captured or routed. Skunk droppings in the orchard at this time were composed chiefly of mouse fur.

Grains.—When corn is in the milk the skunk resorts to this easily-procured food. This fault, together with an occasional raid on the poultry house or apiary, appears to be the only damage that can be laid to skunks. Rats, woodchucks and raccoons frequently are more destructive to corn than the skunk, and during the 1935 season gray squirrels destroyed more standing corn than all other mammals combined. Wheat and oats seem to be little if at all molested by skunks.

Carrion.—During periods of stress much of the skunk's food is composed of carrion. In early spring skunks on Long Island repair to the beaches, where dead fish and other sea food has been washed ashore. During late April, when hunting has accounted for many woodchucks, the fur of these animals not infrequently is found in skunk feces.

TABLE 3

SEASONAL OCCURRENCE OF FOOD BASED ON 1667 STOMACH AND FECAL ANALYSES

(*The numbers indicate the frequency of occurrence in per cent*)

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
No. of Analyses	132	91	26	65	57	81	122	153	124	139	384	293
Fruit	21.6	23.1	38.4	32.3	10.6	14.8	79.4	68.2	86.3	61.4	34.1	21.2
Insects	19.4	8.7	15.4	13.9	54.3	89.0	71.3	47.7	61.4	82.6	30.9	27.6
Mammals	54.4	34.0	69.2	72.1	77.0	32.7	7.3	11.9	1.6	9.4	23.7	31.0
Grains	16.4	46.6	39.0	1.5	—	—	5.8	18.6	29.1	11.3	13.8	10.4
Grasses	31.3	47.2	7.7	3.0	—	—	—	1.3	—	6.5	23.2	34.9
Carrion	22.7	40.6	34.6	6.1	—	—	—	—	—	—	14.2	18.3
Garbage	10.6	18.1	—	—	—	—	—	—	—	—	4.5	7.6
Earthworms	—	—	—	—	—	—	—	—	—	—	6.1	4.8
Birds	—	—	—	—	7.0	3.7	8.2	—	2.4	—	5.2	1.3
Reptiles, amphibians	—	1.1	—	—	—	—	—	2.0	0.8	—	3.9	1.3

Occasionally wool occurs in a scat, and this, palpably, has been taken from a dead sheep. Rarely scales of suckers are recognizable in spring droppings. It is assumed that these are from fish discarded by the fishermen, for it is unlikely that skunks are able to capture a large sucker.

Birds.—Feathers were recovered from 1.66 per cent of the feces examined, their relative frequency in respect to all other items being but 1.46 per cent. Of the 11 feces with remains of birds, 6 contained poultry feathers, while the remainder held small passerine species. During the spring of 1930 I had under observation 3 dens, each of which contained a skunk family. Ovenbirds, veerys, towhees, song and field sparrows nested within 70 paces of the dens, but none were disturbed by skunks.

In the suburbs east of Ithaca, New York, there is a small family burial plot with 6 graves. The plot is on a knoll surrounded by fields and ditches. The gravestones long since have fallen, and under these and on the sides of the knoll are a number of skunk dens. Each spring for the past 4 years, and possibly longer, skunks have raised their young in these retreats. I have watched them closely, and collected many feces about the knoll. Within a stone's throw, and bordering the trails of the animals, pheas-

ants, meadowlarks, killdeers, vesper, song and field sparrows nest each spring. The nests have been located and watched each season. I have yet to obtain any evidence of skunk predation on the occupants of these nests. Insects, fruits, and mice easily are secured, and at this season, these appear to serve the needs of the skunks.

Reptiles and Amphibians.—Snakes are captured with ease. At night, particularly in cool weather, snakes resort to the shelter of stones, and the skunk, flipping over such cover in its search for food, finds the sluggish reptiles. Snake scales were found in 2 feces, while skeletal remains of frogs were recovered twice from droppings. I never have found turtle eggs in the stomach or feces of skunks, although these mammals are recognized as the chief predator of snapping turtles, often digging up and eating the eggs.

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OBSERVATIONS ON THE NEW YORK WEASEL, WITH REMARKS ON ITS WINTER DICHROMATISM

By C. V. Green

Hamilton (1933), in his excellent study of the weasels of New York, has exposed some erroneous opinions that previously had been widely held concerning these small carnivores. He has noted, too, the paucity of information available on certain phases of their life history and food habits. A few observations on *Mustela noveboracensis* (Emmons), made some years ago in Gratiot County, Michigan, supply slight additional evidence as to summer food, confirming as well Hamilton's conclusions on other points.

On one occasion in May, the writer noticed a weasel running beside a small creek and carrying a *Peromyscus* in its mouth. Upon pursuit, the weasel dropped the mouse and escaped by taking to the water and swimming to a bridge, where it disappeared in a hole among the stones.

At another time, also in May, a weasel darted into a hole under a decayed log in a woodlot. Investigation disclosed a nest, composed chiefly of *Microtus* fur and containing 4 young weasels probably less than a week old. Several dead *Microtus* lay in the immediate vicinity. While I uncovered and examined the nest 2 adult weasels, presumably the parents, were very much in evidence, running about excitedly. Finally one of them removed one of the offspring. These observations agree with Hamilton's findings that the summer food consists largely of mice and that the male assists the female in caring for the young.

In south central Michigan, as in New York, not all individuals change to a white winter coat. Although in the northern part of their range, or in regions of high altitude, all examples of *noveboracensis* become white in winter, in the southern part none do so, while in intermediate sections only some individuals change. Hamilton has clearly demonstrated that neither temperature nor the presence of snow is the immediate cause of the change. Other factors, then, besides temperature or snowfall, must be involved. The most obvious of these should be genetic factors influencing pelage color. In the smaller congener, *M. cicognanii*, associated with *noveboracensis* in a part of its range, apparently every individual assumes the white pelage in winter.

Although there is little experimental evidence for the supposition that concealing coloration is a factor determining survival among mammals, Sumner's recent work (1935, 1935a) has demonstrated conclusively that a coloration in harmony with the background tends to protect small fish from both bird and fish predators. Granting that the possession of white fur in the presence of snow similarly might help weasels to avoid capture by enemies, such as owls, selective elimination would tend to operate against individuals remaining brown in winter in localities in which snow lay on the ground for long periods. Conversely, in regions with little or no snow from the southern edge of their

range, selection would favor those animals possessing allelic genes tending to suppress an unpigmented winter coat. In the intervening sections selection could avail them but little, since the weasels present would be in contact with populations on either side respectively homozygous for genes effecting color change and for alleles acting against it. In those localities in which not all individuals become white, one would expect to find the percentage of white winter weasels progressively increasing from south to north, an expectation seemingly in agreement with observations.

Among other genera of mammals in which a white pelage is developed in winter, such as *Dicrostonyx* and some species of *Lepus*, apparently all individuals behave alike. Only in *Alopex*, in which the "blue" phase fails to change color in winter is there encountered a situation at all comparable with that of the New York weasel. That dichromatism in the Arctic fox has a genetic basis is definitely indicated by the data given by Preble and McAtee (1923) for the catch of foxes on St. George and St. Paul islands of the Pribilof group. On the former, where all white foxes taken are killed and only blues are liberated as breeders, less than one per cent are white. On the other islands, where no such selective elimination is practiced, about 17 per cent of the catch is white. What man has done to *Alopex* on St. George Island, natural enemies may have succeeded in doing to the New York weasel in the extremes of its range. In endeavoring to compare *Alopex* with *Mustela*, a minor difficulty arises in that the dichromatism in the former exists from birth, the difference merely being augmented in winter, while in the latter the two color phases are indistinguishable until after the fall molt.

The postulation of genes conditioning the assumption by the weasel of white winter pelage finds an analogy in observations on other mammals in which the full effects of genes are not manifested until after one or two molts. Collins (1923) pictured skins of "buff" and "dark" *Peromyscus maniculatus gambeli*—phases definitely hereditary—between which the difference is visibly greater in the adult than in the juvenal pelage. It is not inconceivable that the weasel possesses genes which influence coat color only at the fall molt.

Sumner (1930), in studying the pigmentation in three subspecies of *Peromyscus polionotus*, the extremes of which are nearly as distinct as the two types of winter pelage in the New York weasel, demonstrated an indubitable, although complex, genetic basis underlying the differences. That only two phenotypes are readily discernible in the weasel instead of many as in *Peromyscus* hybrids, indicates that the genetics of the former is relatively simple.

The explanation advanced for *Mustela noveboracensis* is amenable to testing if, as seems possible from Hamilton's experience, weasels could be bred in captivity. If weasels from the extreme southern portions of their range were taken to an intermediate region, where normally some but not all individuals become white, and were bred together, all offspring should develop brown

winter pelage. Similarly, extreme northern weasels in the same region should produce offspring all of which resembled their parents in type of winter pelage. When northern and southern animals were crossed, the second or succeeding hybrid generations should exhibit young of both types. Inasmuch as Hamilton reported females more prone than males to change in intermediate regions, data on female offspring would be especially important. It may be that in some places males which are genetically one color are sometimes phenotypically the other, either because maleness itself presents an obstacle to gene expression in the presence of certain environmental conditions—perhaps meteorological or of temperature—or because one or more essential genes are sex-linked and a haploid complement is insufficient without the necessary external stimuli.

Merriam (1896) concluded that *cicognanii* was ancestral to *noveboracensis*. Thus it is possible that a white winter coat in *cicognanii* was the earlier condition and that gene mutations effecting a brown hibernal pelage aided a southward extension in range. The eastern varying hare (*Lepus americanus*) seems to become white in winter wherever found (Seton, 1909). Perhaps partly as a result of the conspicuousness of its white pelage in the absence of snow, it has been exterminated in many thickly settled places in the southern part of the territory formerly inhabited, such as southern Michigan (Wood, 1922) and northern Ohio (Enders, 1930), a catastrophe which the varied phenotypes of *Mustela noveboracensis* may have helped that weasel to avoid.

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OBSERVATIONS ON YELLOWSTONE ELK

By Harlow B. Mills

During the reduction of the Yellowstone herd of elk, undertaken early in 1935, I was afforded unusual opportunities to study the parasites, diseases, and pregnancy of this animal. At the time there was maintained a careful check of the animals slaughtered, and this report constitutes a summary of the results.

Pregnancy.—The examination of large numbers of cows of breeding age yielded data concerning the percentage of pregnancy, and the occurrence of twins. Ninety-six among 129 cows or 74.4 per cent, were found to be pregnant. The count of 129 included all cows examined, and thus comprised young, old non-breeders, and barren cows of breeding age.

One cow approaching 21 months of age was found to be pregnant, and from her was obtained a perfectly healthy fetus. The latter was a female, slightly below normal in weight and measurements. After this discovery, the ovaries of 2 cows of the same age were examined. They were unscarred by ovulation, and apparently sexual maturity had not been reached. Mr. William Rush, in charge of wildlife in Region 1, U. S. Forest Service, has studied the elk of Montana and Wyoming and has been led to the conclusion that cows become pregnant in the fall of their third year, when they are approximately 30 months old. There can be no doubt regarding the age of the animal mentioned above, however, for she possessed but two pairs of permanent incisors and five molars.

No single instance of twins was encountered in the post mortem examination of 96 pregnant cows, and they must occur but rarely. There is one unverified report, received from George Larkin, of Gardiner, of the discovery of twin calves in a cow elk shot by hunters in January, 1935.

External parasites.—Three of the cows examined for external parasites were found to be infested with lice of the suborder Mallophaga. These biting lice were rare on the two infested animals at Mammoth, and extremely abundant on the third, examined at the game ranch. Rarely if ever do these parasites affect an animal so seriously as to cause death. Large numbers of eggs and egg shells were found at the bases of the hairs of the heavily infested animal. The insect is transmitted by actual contact, or between animals concentrated in a limited area.

Every animal examined was infested with the winter or moose tick, *Dermacentor albipictus* Packard, and by the last week in January 90 per cent of the animals around Mammoth showed rubbed places about the neck and shoulders that probably were caused by efforts to allay the irritation resulting from these arachnids.

Infestation undoubtedly was worse in the vicinity of Mammoth, Gardiner, and the game ranch, than at Slough Creek. From two square feet of skin

removed from a cow elk at the game ranch, Dr. C. B. Philip, associate entomologist, U. S. Public Health Service, Hamilton, Montana, recovered 310 ticks in various stages of development. These ticks may become sufficiently abundant to cause the death of animals, although this result is uncommon. An elk was reported, December 30, 1934, that had lost most of the hair from the sides. Upon examination two days later it was found that the hair was gone from both sides, from both hind legs as far down as the hocks, and from the region of the occiput. A cursory examination in the field showed the skin to be covered with black, scaly scabs through which a hair occasionally protruded. Samples of the skin for laboratory examination were taken from neck, side, and flank. These were found to be highly infested with a parasitic mite, *Psoroptes*, probably *P. communis ovis* Hering. There can be but little doubt that the attack of this mite was the immediate cause of death, although it was impossible to determine whether it was a primary or secondary factor. One leg had the appearance of being partially shrivelled, but no limping was noticed by those who saw the animal alive. The sheep scab mite *Psoroptes communis ovis* has been reported (Rush, W., Outdoor Amer., pp. 16–17, 1931; Montana Fish & Game Comm., 1931) from elk. The elk may have become infected from the bighorn, to which it was transmitted by domestic sheep.

Internal parasites.—In his study of the Yellowstone elk, Mr. Rush found many occurrences of a parasitic fly of the genus *Cephalomya* (*Cephenomya*), family Cuterebridae, in the nasal passages and in the pharyngeal pouches of both mule deer and elk. Three heads were examined for these parasites, all being negative.

The lungworm *Dictyocaulus hadweni* has been reported from elk in both Yellowstone Park and other parts of the country. The lungs of 25 elk were examined for this parasite. All examinations were negative, although a related species was taken from the lungs of one of the two deer examined at Mammoth. For further data concerning internal parasites, I quote in part from a report of Dr. Howard Welch (in manuscript) concerning his examina- of animals from Slough Creek, and of a calf which was taken for closer inspection to the veterinary laboratories at Bozeman.

"Stomach and Intestinal Tract: The viscera of a calf elk was brought in and examined for parasites. No stomach worms (*Haemonchus* or *Ostertagia*) were found. In the duodenum we found 14 specimens of *Thysanosoma actiniodes*, the common liver tapeworm of sheep . . . Fecal examination of this specimen showed a few free, live, nematode larvae, but no eggs.

"Fecal Examination: Eight specimens. Based upon the Lane method, which gives a very accurate count of a ten-gram sample, the counts were: Coccidia (sp. ?), average count 18; free nematode larvae, average count 14; *Ostertagia* (?), one specimen showed 3 eggs; *Trichuris*, one specimen showed one egg. The free larvae have not been identified. . . . Comparing this count

with those of sheep in normal healthy conditions, one would conelude that these elk are practically free from intestinal parasites."

Diseases.—Twelve blood samples were taken to Bozeman by Dr. Welch, concerning which he reported as follows: "Samples of blood from 12 cow elk were tested for the presence of abortion disease. All were negative."

Agglutination tests on 30 animals, carried on by Dr. C. B. Philip, were negative for *Bacterium tularense* and negative or questionable for *Bacillus abortus*. Twelve of these animals were from Slough Creek; the rest from Mammoth and the game ranch.

Keratitis has been reported in Yellowstone elk by Rush (*loc. cit.*). The eye inflammation of two animals may be referred to this disease, although cultures were not made. One bull was seen at Blacktail with both eyes inflamed and irritated. Another old bull, slaughtered at Slough Creek, was blind in one eye, which was considerably inflamed.

An old cow, trapped at the game ranch, appeared to have the disease commonly known in horses as moon blindness. The laboratory examination of the eyes showed a gray opaque membrane covering most of each cornea. She was not completely blind and could handle herself fairly well in the corral. Apparently she was suffering from a growth resembling cataract. Another cow, trapped at Mammoth, was suffering from a similar growth on the right cornea.

Mouths and tongues of animals were examined for lesions characteristic of necrotic stomatitis. Ten showed evidence of this disease by the loss of teeth, exostisis, and lesions. Not all of these cases were active, some of them having experienced some recovery, as was evidenced only by the loss of molars and pronounced exostisis, usually of the lower jaw. One bull, that had died apparently from this disease, was found along the river between Mammoth and Gardiner. In the roof of the mouth near the teeth large ulcers had eaten far into the nasal sinuses, and were packed full of partially chewed material. The purulent condition of these areas surely must have started an acute toxemia. In an old cow, found at Slough Creek, necrosis had progressed to such an extent that it was possible to extract several of the molars with the fingers.

Ten cows at Mammoth were examined for *Sarcocystis* in the heart. All were infected, several badly. Two calves at Mammoth were not infected. Two cows at the game ranch showed, upon dissection of the heart, *Sarcocystis* in the muscle tissue, while a third apparently was free from infection.

Summary.—In a summary of the diseases and parasites which are found to affect the Northern elk herd, the various diseases and methods of contraction are of interest:

Those transmitted by contact of animals: Lice, scab mites, Bang's disease

Those infections attending poor grazing conditions: *Ostertagia*, *Trichuris Dictyocaulis* (?), *Thysanosoma*, *Sarcocystis*, necrotic stomatitis.

Those transmitted by flying insects: Nose flies (*Cephalomys*).

Those spread by contact with vegetation: Ticks.

Of the 11 diseases and parasites mentioned above, transmission in 9 is greatly aided by overcrowding and by feeding on an overgrazed range. Infestation by nose flies and ticks, however, will be affected indirectly by any betterment of crowded and poor range conditions. When the animals are fewer in number, naturally it will be more difficult for these parasites to reach hosts, and with better range conditions the animals will be in a better position to withstand the ravages of the parasites.

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BROWSING OF THE OLYMPIC PENINSULA ELK IN EARLY WINTER

By Milton P. Skinner

In October and November, 1933, I enjoyed the opportunity of making a study of the elk (*Cervus canadensis occidentalis*) on the Olympic Peninsula of Washington. Here I found 6000 of the animals occupying what I consider to be one of the finest elk ranges that I have ever seen. The area is very wet, with annual precipitation varying from 80, to as much as 200 inches. At the time of my visit the rainy season had just begun, and I should judge that it rained one-half of the time. The elk were living in a magnificent forest of the largest fir, cedar, and hemlock trees that it has ever been my good fortune to see. The mountain scenery, with its jagged peaks and many glaciers, was sublime.

I found here, as I have on other elk ranges, that these animals seldom eat a whole plant, or even sample all of the plants in a favored area. They prefer to eat as they walk, taking the terminal two or three leaves, and then passing. They may walk several steps before taking another bite. Only under severe stress, in winter, do they eat most of a plant. In this normal method of feeding only one plant in several is slightly pruned, the others being untouched. Probably several hours, perhaps days, elapse before another elk visits the same group of plants. Possibly a hundred elk may feed in the same area before a second animal samples a particular plant. Accordingly there is little or no damage to growing forage. Somewhat to my surprise I found no grass being consumed. I did see several animals feeding along an open hillside where grass was growing, but in every case the feeding elk selected only certain herbaceous plants. In summer the food probably is largely herbaceous in character.

Salmon berry.—Apparently, the leaves and tender twigs of salmon berry (*Rubus spectabilis*) were taken more often than any other food. This bush is

common everywhere in the forests from sea-level to at least an altitude of 4000 feet, although above 2000 feet it is small and scattered. In unburned, logged-off sections, it grows rapidly and forms thickets, especially in damp places. It persists commonly for 12 or 15 years before other bushes and trees begin to suppress its luxuriant growth. Salmon berry is said to retain its leaves all winter in this region.

Huckleberries.—Second in importance were the box blueberry (*Vaccinium ovatum*) and the red whortleberry (*Vaccinium parvifolium*), growing as bushes of 10 feet or more in height. Both species are considered together because locally they are known indiscriminately as huckleberries. These bushes are common, growing under the forest trees in both dry and moist locations from sea-level to 5000 feet, but are scarcer at the higher elevations. At least the former species is evergreen, and the leaves are available throughout the winter. The leafage is naturally rather scanty, although the plants often are abundant. The more tender twigs seem to be relished as much as are the leaves. These bushes grow on logged-off tracts as well as in the forests.

Maple and vine maple.—Third in palatability appear to be the leaves and stems of the maple (*Acer macrophyllum*) and vine maple (*Acer circinatum*). The maple is an important tree in many parts of the peninsula, growing both in groves and singly. The vine maple occurs abundantly as a shrub or low slender tree, under the firs and other conifers, and below an altitude of 3000 feet. Since it seldom stands erect and its crown carries a heavy leafage that readily is reached, it is an important food, although not eaten as often as the plants previously mentioned. Fortunately, it can grow under quite heavy shade, and the heaviest snows bend the bushes only a little lower. This maple grows rather slowly, but this disadvantage is balanced by longevity to the extent of 80 or 90 years (Sudworth, 1908, pp. 389–392). It reproduces by seeds, or by the rooting of a bent branch.

Devil's club.—Although *Fatsia horrida* is too prickly and poisonous for man to touch, the elk seem to relish its large leaves. It is a large shrub, growing to a height of 10 feet or more, both in the forests and in moist places on logged-off areas. I found it to be quite common, and I noted that the plants still retained leaves as late as November 4.

Deer fern.—*Struthiopterus spicant* is fairly common, and the fresher, younger fronds are much sought by the elk. The dark green rosettes, with fronds about a foot in length, are evergreen. This fern prefers a rich, moist soil in cool, shady forests, from sea-level to 3500 feet elevation. At times I found it growing on logged-off sections.

Sword fern.—*Polystictum munitum* is very abundant everywhere under firs and hemlocks. As one man aptly said: "If the elk will eat sword fern, they need never starve on the Olympic Peninsula." They do eat the younger, fresher fronds at times; but this fern does not stand grazing as well as the deer fern, and it may disappear altogether in certain localities. The fronds

often are 3 feet in length and 6 inches wide, rising in graceful clumps from a central rootstock. It is evergreen and its leaves are available throughout the year. It grows best in the rich, shaded soils of the valleys, from sea-level to 3000 feet elevation.

Other varieties of ferns also are eaten by the elk, but I identified no others with certainty.

Blackberry.—In certain localities I found blackberries (*Rubus*) growing luxuriantly in dense, brushy thickets. To my surprise, I learned that these plants are not native, but have escaped from cultivation. They are very numerous on moist lowlands near the rivers. In one or two instances, I noted that an elk had nipped a leaf or two. While these brushy blackberries are not eaten often, there is a small, creeping, native *Rubus* whose leaves are sought by the elk. The native species grows in the forests from sea-level to 1000 feet altitude, and I found it growing also on logged-off lands.

Fungi.—Because of the excessive moisture, fungi of many kinds grow on the ground, on rotting logs, on stumps, and on erect stubs and trunks of trees, both alive and dead. So many are eaten that evidently they constitute an important food of the elk, at least at this time of year. Naturally, they are most abundant in low, cool, damp forests, but I found edible sorts in the mountains as high as 4000 feet elevation. Fungi growing on the forest floor are sought diligently by the elk. In one or two instances, I actually saw elk pawing to uncover mushrooms indiscernible from the surface of the ground. Both tree fungi and mushrooms are found in moist places in logged areas, as well as throughout the growing forests.

Alder.—Along almost every one of the rivers there are many groves of fine, large alders (*Alnus oregona*), often 50 or more feet in height, and with trunks 12 to 15 inches in diameter. Although seemingly confined largely to river valleys, they grow actually from sea-level to at least 3000 feet elevation. These trees produce seeds in abundance, and the seedlings are common on rich soil in dense shade. They grow rapidly during their first 20 years and then live 30 or 40 years longer. The elk are partial to the leaves and stems of the seedlings and young trees, and the larger trees provide fallen leaves in the autumn. At times the elk gouge out mouthfuls of the bark.

Mosses.—Mosses grow luxuriantly everywhere in the moist, lowland forests, on the ground, on rocks, on fallen logs, and on the trunks of both dead and living trees. Many of the numerous species are eaten by the elk, but in the autumn, at least, this food is not as important as are those already named.

Willows.—Various species of *Salix* border the streams, and grow in moist places from sea-level to snow-line. Their leaves and twigs are eaten at times, but are not taken in quantity as long as better foods can be procured.

Salal.—Gaultheria shallon is an evergreen shrub often growing in extraordinarily luxuriant and dense thickets, especially on partly shaded, logged-off

sections, and on some of the "blow-downs." I did not find salal growing on river bottoms, but it is common in the forests from sea-level to at least 3000 feet altitude. Like most of the plants mentioned here, it is most abundant at lower elevations, and gradually disappears as the altitude increases. It grows on both dry and moist soils. Elk will eat its leaves when they can get nothing better, but it is, properly speaking, an emergency ration. Only once did I find plants where a leaf or two had been severed by elk.

Douglas fir and hemlock foliage.—When nothing else can be had, the elk will eat the needles of both Douglas fir (*Pseudotsuga taxifolia*) and western hemlock (*Tsuga heterophylla*).

At times, the elk seek rotting logs of Douglas fir that fast are changing to red earth. It is said that they eat this rotting wood for the sake of the saline ingredients. I could not verify this statement, although I did find a log of this sort that recently had been disturbed by an elk, either by pawing or by biting. I could discover nothing saline about it. Elk, of course, require alkaline material, and probably they procure this from salt-licks.

All of the foods above mentioned are common in the forests of the southwestern and western sides of the peninsula, where the rainfall is heaviest, and this is where live four-fifths of the Olympic elk. In the drier sections of the northern and eastern parts of the peninsula, I found all the kinds of browse named, but in decreased abundance and luxuriance. The fact that the rainfall is much heavier on the southern and western than on the northern and eastern areas must determine to a great extent the quantity of browse. Other climatic factors and the character of the soil must be influential as well. Probably one-fifth as many elk live on the north as on the west side. While a few bands are to be found in winter on the eastern side of the divide, most of the animals mingle in summer with those of the western side, and then recross the ridge in the fall.

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A REVISION OF THE PIPISTRELLUS HESPERUS GROUP OF BATS

By Donald M. Hatfield

An interest acquired in *Pipistrellus* of the western United States, while collecting specimens in the field, led me to study the material in the Museum of Vertebrate Zoology. Briefly, the results of my study of this material, supplemented by some borrowed specimens, are the recognition of five geographic races of the species *Pipistrellus hesperus*. Two of these races here are named as new.

I wish to make grateful acknowledgments to the following persons for the loan of specimens in their collections or care: Stanley G. Jewett, Edward R. Warren, A. Remington Kellogg, Hartley H. T. Jackson, and Ralph Ellis. I wish also to express my appreciation of the assistance received in the present study from J. Grinnell, and especially from E. R. Hall of the Museum of Vertebrate Zoology.

LIST OF SPECIES AND SUBSPECIES

Pipistrellus hesperus hesperus (H. Allen)

Scotophilus hesperus H. Allen, Monogr. Bats North Amer., p. 43, 1864.
Vesperugo hesperus True, Proc. U. S. Nat. Mus., vol. 7 (1884), p. 602, 1885.
Pipistrellus hesperus Miller, North Amer. Fauna, no. 13, p. 88, 1897.
Pipistrellus hesperus hesperus J. Grinnell, Proc. Calif. Acad. Sci., vol. 3, p. 279, 1913.

Type Locality.—Old Fort Yuma, Imperial County, California, on right bank of Colorado River, opposite present town of Yuma, Arizona.

Range.—Roughly, the Great Basin area of the western United States, south from Almota, Whitman County, Washington; and also, southeastern California, northwestern Arizona, and northeastern Lower California, Mexico, south to Cataviña; west to the Sierra Nevada, and east in southern Utah to Goodridge, San Juan County.

Diagnosis.—Size: Medium for the species (see measurements). Color: Dorsally between drab gray and smoke gray, and ventrally between smoke gray and pale smoke gray (color terminology according to Ridgway, "Color Standards and Color Nomenclature," 1912).

Comparisons.—From *Pipistrellus h. merriami*, *hesperus* differs primarily in its lighter color, with no other apparent characters distinguishing it excepting slightly smaller average size. Compared with *australis*, *hesperus* is lighter in color and larger (forearm averaging 29.4 as against 28.4 mm. in *australis*). As compared with *maximus* and *santarosae*, *hesperus* is smaller in every measurement taken (forearm less, rather than more, than 31.5 mm.) and is lighter in color than *santarosae*.

Measurements.—Average and extreme measurements in millimeters of 14 adults from the vicinity of the type locality. Total length, 71.8 (66–74); tibia, 12.0 (10.7–13.5); forearm, 29.4 (27.8–31.0); greatest length of skull, 11.9 (11.5–12.3); breadth of braincase, 6.3 (6.1–6.4) mm.

Remarks.—*Pipistrellus hesperus hesperus*, possibly because of the great extent of its range, is the most variable of the 5 races. At various points, even in the center of its range, individuals are found with characters which approach those of one or another of the surrounding subspecies.

The identification as *P. h. hesperus* of the specimen from Almota, Washington, is tentative; it has been so long in alcohol that its color is of little diagnostic value.

Specimens examined.—Total number, 304; arranged alphabetically by states and within states by localities from north to south, as follows: **Arizona:** *Mohave County:* 10 mi. north of Wolf Hole, 3800 ft., 5; Nixon Spring, Mount Trumbull, 6250 ft., 1; Mellen, Colorado River, 6; foot of the Needles, 2; above Bill Williams River, 3. *Yuma County:* 10 mi. below Cibola, 8; 5 mi. north of Laguna, 2; Tinajas Altas, Gila Mountains, 3 (coll. Ralph Ellis). *Coconino County:* 5 mi. south of summit Navajo Mountain, 1. *Navajo County:* Skeleton Mesa, about 16 mi. west-northwest of Kayenta, 8000 ft., 1; Right Fork Segi-ot-sosie Canyon, 11 mi. northwest of Kayenta, 2. **California:** *Mono County:* 2 mi. south of Benton Station, 4. *Inyo County:* Silver Canyon, 7000 ft., 3; 2 mi. north of Independence, 2; Lone Pine Creek, 4500 ft., 7; Death Valley, Salt Creek, 2; 15 mi. north of Darwin, 1; Emigrant Spring, 13; Furnace Creek Ranch, 1; Wild Rose Canyon, 1; Warm Sulphur Spring, 1; Little Lake, 2; Shoshone, 2. *Kern County:* Fay Creek, 3; Weldon, 1; Onyx, 3; west slope of Walker Pass, 4600 ft., 3; Kern River, 12 mi. below Bodfish, 1. *San Bernardino County:* 1.5 mi. northeast of Barstow, 1; opposite the Needles, Colorado River, 12; Victorville, 1; Cushenbury Springs, 5; 4 mi. north of 29 Palms, 1; 14 mi. northeast of Blythe Junction, 1. *Riverside County:* Banning, 1; Cabezon, 1; Palm Springs, 2; Dos Palmos Springs, 5; Thermal, 2. *Imperial County:* 2 mi. north of Picacho, Colorado River, 7; 24 mi. south of Palo Verde, Colorado River, 1; 8 mi. east of Picacho, Colorado River, 7; Potholes, Colorado River, 3; 4 mi. south of Potholes, Colorado River, 1; Near Pilot Knob, Colorado River, 18. **Nevada:** *Washoe County:* mouth Little High Rock Canyon, 5000 ft., 8; Deep Hole, 4000 ft., 1. *Churchill County:* 4 mi. west of Mountain Well, 5000 ft., 1. *Mineral County:* 3 mi. south of Schurz, 4100 ft., 7; east of Walker River, 2 mi. northwest of Morgan's Ranch, 5050 ft., 1; Cottonwood Creek, Mount Grant, 7400 ft., 3. *Esmeralda County:* 7 mi. north of Arlemont, 5500 ft., 4; Cave Spring, 6200–6248 ft., 9; Fish Lake, 4800 ft., 12. *Nye County:* Middle Stormy Spring, 11 mi. south of Lock's Ranch, 5000 ft., 1; northwest base of Timber Mt., 4200 ft., 1; Amargosa River, 3400–3500 ft., 3–4 mi. northeast of Beatty, 30; Amargosa Desert, 20 mi. southeast of Beatty, 2500 ft., 1; Ash Meadow, 2.5 mi. west of Devil's Hole, 2173 ft., 2. *Lincoln County:* Crystal Spring, 4000 ft., Pahranagat Valley, 12; 5 mi. south of Crystal Spring, Pahranagat Valley, 1; 3800–4000 ft., Ash Spring, Pahranagat Valley, 5. *Clark County:* 0.5–2 mi. north of California-Nevada Monument, 500 ft., 3; Hiko Spring, 8 mi. southeast of Dead Mt., 1000 ft., 2. **Oregon:** *Harney County:* Trout Creek, 2 (coll. S. G. Jewett). *Sherman County:* Millers, Mouth of Deschutes River, 1 (Biol. Surv.). *Malheur County:* 2 mi. northwest of Riverside, 1 (Biol. Surv.); Watson, 10 (Biol. Surv.). **Utah:** *San Juan County:* Navajo Mt. Trading Post, 5 mi. southeast of Navajo Mt., 1; Rainbow Bridge, 1; Goodridge, 1.5 mi. south of Mexican Hat, 13. **Washington:** *Whitman County:* Almota, 1 (Biol. Surv.). **Lower California, Mexico:** Las Palmas Canyon, 200 ft., west side of Laguna Salada, 4; 13 mi. north of El Mayor, 3; Laguna Hanson, 5200 ft., Sierra Juarez, 1; San Jose, 2500 ft., Lat. 31° N., 1; Vallecitos, 1; La Grulla, 7500 ft., San Pedro Martir Mts., 2; El Cajon Canyon, 3200 ft., east base San Pedro Martir Mts., 5; Cataviña, 1850 ft., 1.

Pipistrellus hesperus merriami (Dobson)

Vesperugo merriami Dobson, Ann. and Mag. Nat. Hist., ser. 5, vol. 18, p. 124, 1886.
Pipistrellus hesperus merriami Grinnell, Proc. Calif. Acad. Sci., ser. 4, vol. 3, p. 279, 1913.

Type Locality.—Red Bluff, Tehama County, California.

Range.—Restricted to California west of crest of Sierra Nevada; from San Diego County north to Tehama County.

Diagnosis.—Size: Medium for the species. Color: Variable dorsally from buffy brown to army brown; ventrally from wood brown to buffy brown.

Comparisons.—From *P. h. hesperus, merriami* differs in being darker colored. Com-

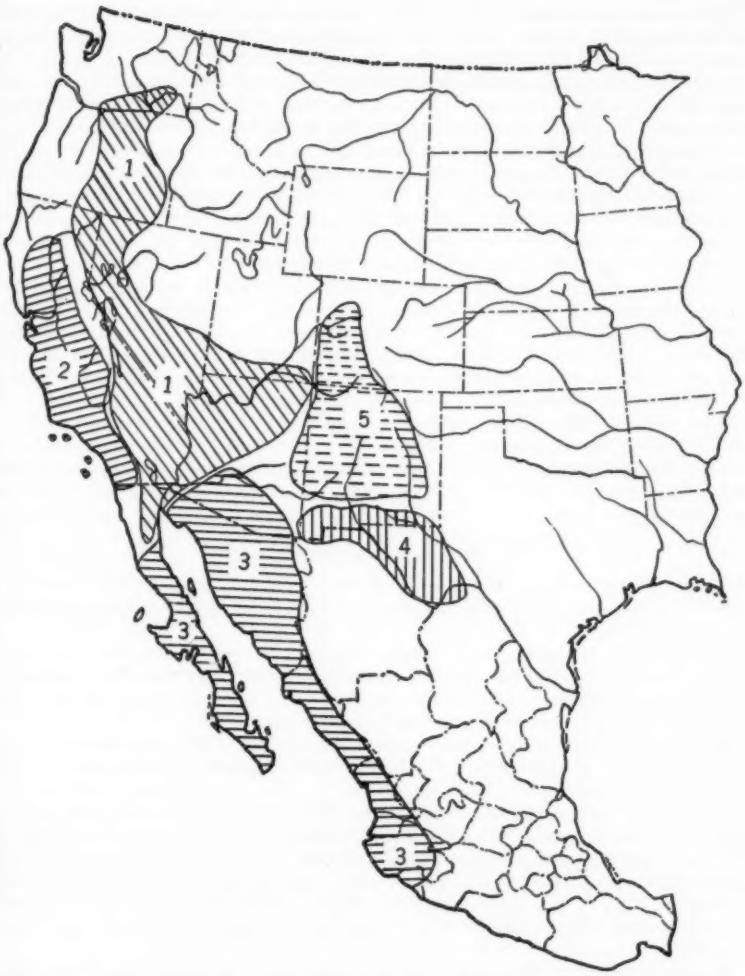

FIG. 1. Distribution of the subspecies of *Pipistrellus hesperus*. 1, *P. h. hesperus*; 2, *P. h. merriami*; 3, *P. h. australis*; 4, *P. h. maximus*; 5, *P. h. santarosae*.

parisons with *hesperus, australis, maximus* and *santarosae* are made in the accounts of those races.

Measurements.—Average and extreme measurements of 16 adults from California: Total length, 71.3 (66–78); tibia, 11.2 (10.6–11.7); forearm, 28.9 (27.5–30.8); greatest length of skull, 11.8 (11.3–12.2); breadth of braincase, 6.4 (6.0–6.6) mm.

Remarks.—Burt (1933, p. 115), on the basis of certain specimens from southern Arizona and northeastern Sonora, Mexico, has suggested that the ranges of the races *merriami* and *hesperus* may be comparable to those of the respective races *Myotis c. californicus* and *M. c. pallidus*. That is to say, the range of *merriami* may surround the Great Basin. The evidence at hand does not support this view, for such specimens as I have seen from southern Arizona are referable rather to *australis* than to *merriami*. Furthermore, it seems doubtful that *merriami* would be able to surmount the barrier of mountains extending northward beyond the northern limits of its range if it occurs mainly in the Upper Sonoran Life Zone, as Grinnell (1933, p. 91) suggested.

Specimens examined.—Total number, 55; all from California, arranged by counties from north to south as follows: *Tehama County:* Dales, on Paines Creek, 600 ft., 3. *Sutter County:* Butte Slough, 1. *Yolo County:* Rumsey, 3. *Eldorado County:* Limekiln, 2; Fyffe, 1. *Solano County:* 3 mi. west of Vacaville, 1. *Contra Costa County:* 8 mi. east of Clayton, 1. *Mariposa County:* Yosemite Valley, 3; El Portal, 1; Pleasant Valley, 2. *Madera County:* Raymond, 3. *Fresno County:* Shaver Ranger Station, 1; Minkler, 1. *Monterey County:* Abbott Ranch, 1. *Tulare County:* 7 mi. north of Springville, 2100 ft., 1. *San Luis Obispo County:* Cuyama Valley, 1. *Kern County:* Fort Tejon, 3. *Los Angeles County:* San Francisquito Canyon, 1; Pasadena, Rubio Wash, 3. *San Diego County:* Borego Spring, 1; Escondido, 14 (13 in coll. Ralph Ellis); La Puerta Valley, 1; Vallecito, 4; Carrizo Creek, 1.

Pipistrellus hesperus australis Miller

Pipistrellus hesperus australis Miller, North Amer. Fauna, no. 13, p. 90, 1897.
Pipistrellus hesperus apus Elliot, Field Columb. Mus., Zool. Ser., vol. 3, no. 15, p. 269, 1904.

Type Locality.—Barranca Ibarra, Jalisco, Mexico.

Range.—In so far as known, north from the type locality to Camp Verde, Arizona; east in southern Arizona to Dos Cabezos and Fort Bowie, Cochise County, and in Lower California, Mexico, north at least to San Ignacio, latitude 27° 15′ N.

Diagnosis.—Size: Small for the species. Color: Dorsally between cinnamon drab and drab, and ventrally wood brown to light drab (as determined from specimens from Lower California).

Comparisons.—As compared with *P. h. merriami, australis* differs in being smaller, in having on the average an actually and relatively narrower brain case (52 per cent of length of skull in *australis*, 54 per cent in *merriami*), and less reddish coloration. As compared with *P. h. hesperus, australis* differs as from *merriami* except in color, which is darker. From *P. h. maximus, australis* differs in being much smaller and darker. In addition, the pelage is shorter than in *maximus* (average: 7.8 in *australis*, 8.9 mm. in *maximus*).

Measurements.—Average and extreme measurements of 14 adults from Lower California, Mexico: Total length, 67.1 (60–72); tibia, 11.3 (10.1–12.3); forearm, 28.4 (26.3–30.0); greatest length of skull, 11.7 (11.3–12.0); breadth of braincase, 6.1 (5.9–6.3) mm.

Remarks.—The specimens from San Ignacio, Lower California, on the basis of color, appear to be intergrades between *australis* and *hesperus*, but their small size justifies, I believe, their allocation to the subspecies *australis*.

Although Burt (1933, p. 115) has suggested that *P. h. apus* Elliot (of which I have

seen no specimens from the type locality) be placed in the synonymy of *merriami*, it seems more probable that the name was given to intergrades between *australis* and *maximus*. Their relationship to *maximus* may account for their size, which is somewhat larger than is characteristic of *australis*. In the present writer's opinion, therefore, *Pipistrellus hesperus apus* Elliot should be placed in the synonymy of *P. h. australis*. The specimens from Dos Cabezos and Fort Bowie, Arizona, definitely are intermediate between *australis* and *maximus*.

Specimens examined.—Total number, 26; arranged by locality from north to south as follows: **Arizona:** *Yavapai County:* Camp Verde, 5 (coll. S. G. Jewett). *Pima County:* Bates Well, 1. *Cochise County:* Fort Bowie, 1 (Biol. Surv.); Dos Cabezos, 1 (Biol. Surv.). **Lower California, Mexico:** San Ignacio, 500 ft., 2; Comondu, 1000 ft., 4; El Sauz, Victoria Mountains, 4000 ft., 4; Agua Caliente, 800 ft., 6; Miraflores, 600 ft., 2.

Pipistrellus hesperus maximus new subspecies

Type.—Female, adult, skin and skull; no. 21344/36997, U. S. Nat. Mus.; Dog Spring, Grant County, New Mexico; June 6, 1892; collected by Edgar A. Mearns and F. X. Holzner; original no. 1854.

Range.—In so far as known, southern New Mexico and western Texas.

Diagnosis.—Size: Large; forearm more than 31.5 mm. Color: Between smoke gray and pale drab.

Comparisons.—Compared with *P. hesperus hesperus*, *maximus* differs in being larger in every measurement taken; the forearm is more than 31.5 mm. long in *maximus* and, except in three specimens, is less in *hesperus*. Also, the nasofrontal area is less "dished" than in *hesperus*. Compared with *merriami*, *maximus* differs as from *hesperus*, and in addition is lighter in color. Compared with *australis*, *maximus* is larger, lighter in color, and has longer pelage. From *santarosae*, *maximus* is distinguished by lighter (grayish as opposed to reddish) coloration.

Measurements.—Average and extreme measurements of 7 adults (including the type specimen) from the type locality: Total length, 80.3 (78–83); tibia, 12.3 (11.7–13.1); forearm, 32.9 (31.8–33.3); greatest length of skull, 12.7 (12.3–12.9); breadth of braincase, 6.6 (6.5–6.7) mm.

A single male from El Paso, Texas, has a total length of 78, forearm measuring 32.4, and skull 12.6 mm. in length.

Remarks.—Specimens of this race, as of *santarosae*, attain larger size than those of other races of the species. In color of pelage, *maximus* closely approximates the race *hesperus*, but size of skull and length of forearm place it apart from that subspecies.

Specimens examined.—Total number, 22; arranged by locality from north to south as follows: **New Mexico:** *Luna County:* Florida Mountains, 1 (Biol. Surv.). *Otero County:* Guadalupe Canon, 4 (U. S. Nat. Mus.). *Eddy County:* Carlsbad Cave, 3 (Biol. Surv.). *Grant County:* Dog Spring, 7 (U. S. Nat. Mus.); Animas Valley, 1 (Biol. Surv.). **Texas:** *El Paso County:* El Paso, 1 (U. S. Nat. Mus.). *Presidio County:* Paisano, 5 (Biol. Surv.). *Terrell County:* Sanderson, 1 (Biol. Surv.).

Pipistrellus hesperus santarosae new subspecies

Type.—Female, adult, skin and skull; no. 118756, U. S. Nat. Mus., Biological Survey Coll.; Santa Rosa, Guadalupe County, New Mexico; October 6, 1902; collected by Jas. H. Gaut; original no. 568.

Range.—In so far as known, northern New Mexico and western Colorado.

Diagnosis.—Size: Large; forearm more than 31.5 mm. long. Color: Between buffy brown and wood brown of Ridgway.

Comparisons.—Compared with *P. h. maximus*, *santarosae* is darker in color, but dif-

fers hardly at all in size. From *P. h. hesperus*, *santarosae* differs in being larger (forearm more than 31.5 in *santarosae*, less than 31.5 mm. in *hesperus*), and darker colored. From *P. h. merriami*, *santarosae* differs in being larger and more reddish in coloration. Compared with *P. h. australis*, *santarosae* is much larger and has longer pelage (average: 7.8 in *australis*, 9.0 mm. in *santarosae*).

Measurements.—Average and extreme measurements of 8 specimens from northern New Mexico: Total length, 82.0 (80–86); tibia, 12.4 (11.9–13.0); forearm, 32.8 (31.7–34.1); greatest length of skull, 12.7 (12.3–13.1); breadth of braincase, 6.6 (6.3–6.8) mm.

Remarks.—The only specimen examined from Colorado was taken at Bedrock, Montrose County. It appears, both on the basis of size and of color, to be an intergrade between *hesperus* and *santarosae*. In external measurements it is as large as the largest *hesperus* measured, but in color it is somewhat darker than typical *hesperus*. For this reason it is referred here to *santarosae*.

Specimens examined.—Total number, 8 (unless otherwise indicated, from the Biological Survey collection) arranged by locality from north to south as follows: **Colorado:** *Montrose County:* Bedrock, 1 (coll. E. R. Warren). **New Mexico:** *Sandoval County:* Jemez, 1. *Valencia County:* Laguna, 1. *Guadalupe County:* Santa Rosa, 4. *Socorro County:* Socorro, 2.

Geographical variation, noted above, consists principally of variation in color and in actual size, although in one race, *australis*, the skull has distinctive relative proportions. The following key presents in concise form certain of the differences relied upon to distinguish the races one from the others:

1. Coloration gray (pale smoke gray to drab gray).
    2. Size less (forearm less than 31.5 mm.).....*hesperus*
    2′. Size greater (forearm more than 31.5 mm.).....*maximus*
1′. Coloration brown (light drab to army brown).
    3. Size less (total length under 80 mm.; forearm less than 31.5 mm.).
        4. Skull broader (breadth averaging 54 per cent of length); color dorsally buffy brown to army brown .....*merriami*
        4′. Skull narrower (breadth averaging 52 per cent of length); color dorsally cinnamon drab to drab .....*australis*
    3′. Size greater (total length 80 mm. or more; forearm more than 31.5 mm.).....*santarosae*

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A SECOND OCCURRENCE OF HEADDOT SPOTTING IN THE HOUSE MOUSE

By Clyde E. Keeler and Hubert D. Goodale

In April, 1935, Keeler (Proc. Nat. Acad. Sci., vol. 21, pp. 379–383) reported the discovery early in 1931, and the subsequent genetic investigation, of a new type of spotting in the house mouse (fig. 1). Unpigmented hair (or skin) in this type of spotting occurs in about the same body regions as in other types of spotting, but the extent of the areas affected and the order of their appearance, as the total amount of white spotting increases, are different, as is indicated in table 1. It will be observed that the other 4 spotting types first manifest themselves in a white tail tip, and, as the amount of white increases, in white feet, white belly-spot, white head blaze, and lastly, in a white belt. It also will be noted that no type develops a white blaze on the head unless tail, feet and belly also are affected. But in headdot spotting of

TABLE 1

Spotting types	*Centers affected*					
	TAIL TIP	FEET	BELLY SPOT	HEAD BLAZE	BELT	LOWER LIP
Recessive piebald, Berlin blaze } allels....	1	2	3	4	5	—
	1	2	3	4	—	—
Flex tail, anemia, belly spot...	1	2	3	4 (rare)	—	—
Dominant lethal spotting.....	1	2	3	4	5 (rare)	—
Bussey headdot.....	2	5 (rare)	4 (rare)	1	—	3 (rare)

the lowest grade, a white spot occurs on the forehead only, and this is the most common type. As the amount of headdot spotting increases, white appears successively on tail tip, lower lip, belly, and feet.

This peculiarity led to the conclusion that headdot is a new inherited type of spotting, and that it is not a bizarre allel or modification either of Berlin blaze or of recessive piebald. It is irregular in its inheritance in that although generally it behaves as a recessive unit-character, it may fluctuate from a condition in which heterozygotes develop the character, to one in which it seems probable that even homozygotes fail to develop a headdot. This fluctuation probably is due, at least in part, to modifying genes.

In August 1935, Goodale exhibited at the Woods Hole Genetics Meetings mice (fig. 2) having a spotting pattern very similar to that described for headdot. This, as we have stated above, readily may be distinguished in most specimens from the other known types of spotting. This strain originated from a single headdot male, also discovered in 1931, that, when mated to related selfs, produced about equal numbers of headdots and selfs. It had been selected for increased size of headdot, and this resulted in a higher

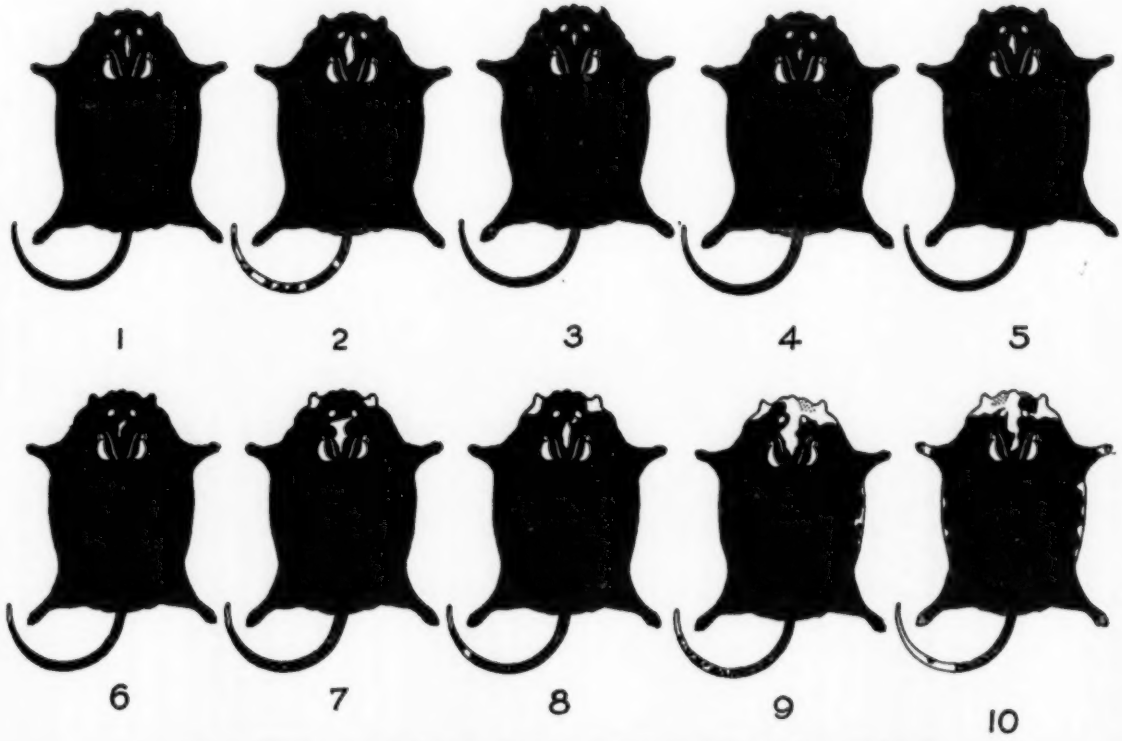

FIG. 1. DETAILS OF THE HEADDOT SPOTTING AS DISCUSSED IN THE PRESENT PAPER

average amount of white than was found in the strain at the Bussey Institution described by Keeler. There are other differences, also, and thus the description of the Bussey strain appearing at the beginning of this paper is not applicable to the Mount Hope strain.

In order to ascertain whether the resemblance between the two strains is due to some common genetic factor, a cross has been made between them. A male of the Mount Hope stock (fig. 2) was mated with a female of the Bussey stock. Eight young were produced (figs. 3 to 10), all of which bore some grade of headdot spotting. It is known that animals of as low a grade as that shown in figure 1, when crossed to a self or a Berlin blaze, usually produce selfs and but rarely an animal with one or several white hairs on the head. Hence, if the Mount Hope headdot were a bizarre, selected type of Berlin blaze, self young would be expected. If the Mount Hope headdot were due to a mutation at a locus other than that of the Bussey mutation, selfs also would be expected. Actually, among the 8 offspring there are individuals with less white than that shown by the mother, and others with much more white than is shown by the father. Thus, it follows that the Mount Hope headdot strain probably contains in its genetic complex the principal gene present in the Bussey headdot strain previously described. The wide range in amount of white spotting among the F_1 offspring between the two strains very likely is due to differences in the modifiers present in each, which in some instances supplement one another in producing the large amount of white shown by the individuals represented in figures 9 and 10.

In addition, it will be noted that these F_1 hybrids between the two strains definitely establish as centers of leucotic manifestation the lower lip, a row of small white broken spots upon the midventral line, and white feet, in the case of those individuals bearing the highest grade of headdot spotting, (figs. 9 and 10).

Since the Mount Hope strain of headdots had some ancestry derived from Bussey Institution mice, it is possible that both stocks may have derived the principal headdot gene from a common source, and that the degree of manifestation distinguishing the two strains is one of modifying factors differing in the two strains. The unlike complements of modifying factors may have come from the unrelated parts of the ancestry of the two strains.

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BREEDING BACK THE EXTINCT AUEROCHS

By Theodore G. Ahrens

Doctor Lutz Heck, Director of the Berlin Zoo, and his brother, Director of the Munich Zoo, have been engaged for some time in an interesting series of experiments concerned with the attempt to breed back, from the most suitable types of living wild cattle, to the progenitor of all European cattle, the ur or auerochs, now extinct.

Lutz Heck published in 1934 a monograph, "Ueber die Neuzüchtung des Ur oder Auerochs," from which most of the following has been taken. It generally is agreed that our modern domestic cattle are derived originally from the ur or auerochs (*Bos primigenius* Linnaeus). The other European wild cattle, the wisent (*Bison bonasus* Linnaeus) not only are of a different type, but their whole manner of living rendered them unsuitable for domestication. The auerochs became extinct about 300 years ago, but we have so many descriptions and so many pictures, dating all the way from the sixteenth century back to the cave drawings of France and Spain, that we know the characteristics of the animal. Heck travelled extensively for the purpose of observing all known types of wild or halfwild cattle now living, and in his breeding experiments he has collected in the Berlin Zoo a very large number of races of pure and crossbred cattle. At present there are about 20 crossbreeds of the cattle of South France and Corsica, and a considerable collection of other sorts. In all there are about 80 individuals of some 23 varieties. Heck concluded that breeding back to the extinct auerochs is possible.

General sorts of living cattle bear a resemblance to the auerochs. Among these are the fighting cattle of South France, the Iberian, especially the Spanish fighting bulls, and the half wild cattle of Corsica. These 3 have preserved best the primitive form, and scarcely any of the original traits have been altered.

The fighting cattle of South France bear a strong resemblance to the extinct auerochs. Their home is the Rhone delta and particularly the island of Camargue, situated between the two principal branches of the Rhone. These cattle are relatively small, but speedy and active. They are used principally for bloodless bull fights, which are held in all cities and villages of Provence. In color they generally are black, and in winter they have long coats of hair. They have well formed horns bending first to the side and then straight forward, similar to all ancient pictures of the auerochs. These cattle are bred to preserve their primitive wildness and have few, if any, of the traits of ordinary domestic cattle.

There are five principal herds of these cattle, comprising between 850 and 900 head. They live unprotected winter and summer. It is interesting to note that the Camargue horses belong also to an ancient race. Their color is mostly gray, and they well may be descended from Saracen horses, brought here centuries ago and interbred with domestic stock.

As the very fertile soil of this region has been used for agricultural purposes to an increasing extent, a nature reserve of about 10,000 hectares, known as the Reserve Zoologique et Bontanique de Camargue, has been created by the efforts of the Société Nationale d'Acclimatation, Paris. During migration great numbers of wild birds live or congregate in this area. Here are found flamingoes, to the number of 7000 in migration and even breeding, herons of various kinds, northern coast birds, and great numbers of ducks, besides the last surviving Rhone beavers, some 120 in all. It is proposed to introduce the cattle also into this reserve. Heck purchased 5 head of these cattle from the herd of the Marquis de Baroncelli, one bull, two cows, one bull calf and one cow calf, and brought them safely to Berlin. The bulls also have been bred to Corsican mountain cattle and to English park cattle.

Iberian cattle.—Many Iberian domestic cattle bear a marked resemblance to the auerochs, which formerly lived on the peninsula, as attested by the numerous cave drawings made by early man. The Spanish fighting bulls are bred chiefly in Andalusia. In Europe and Spanish America, according to a statement of 1932, 454 bull fights were held; 217 in Spain, 37 in France, 18 in Portugal, 98 in Mexico, 38 in Ecuador, 19 in Columbia, 18 in Venezuela and 9 in Peru. Between 8000 and 10,000 bulls, including the so-called novillados (4 year olds) are required annually for this purpose. These bulls live in meadows and open country, as formerly did the auerochs. The wisent is a forest animal. There are some 80 herds included in the Union of Bull Breeders, and of these one of the best is that of Juan B. Conradi, near Seville. Here Heck obtained a bull and two cows. This bull also was used for crossbreeding with Corsican, Highland, Park, Angus, and with hornless Swedish cattle.

Corsican cattle.—The Corsican is not primarily a fighting breed of cattle, but is semi-domesticated. It is used for draft, meat, and milk, and is of medium size. Generally of a deep black color, its horns are not as long as those of the auerochs, and it is slower in movement than the French or Iberian races. Heck procured one bull and three cows. This herd has increased considerably and the bull was bred to Swedish hornless, Park and to Steppe cows. A curious fact about these Corsican cattle is that the calves are born red and change to black in 5 or 6 months. They, also, are long-haired in winter.

In general it is very difficult to find anywhere in Europe an area in which there has been crossbreeding of many kinds of cattle without any particular object in view, and hence, where one might expect that there would be an eventual recurrence to the auerochs type. Heck found favorable conditions on the Aland Islands and notably the island of Lemland, into which various races of cattle had been introduced without any definite plan of breeding. Danish, Friesian, Ayrshires of Scottish origin, hornless Finnish, and Swedish cattle also had been utilized. Among them every possible color could be observed, even that typical of the auerochs.

All in all there can be no doubt as to the advantages of crossbreeding between Iberian, South French, and Corsican cattle for the purpose of eventually breeding back to the auerochs. In color, shape, position of the horns, even in trend of intelligence, the Spanish fighting bulls are entirely of the auerochs type. The South France fighting bull is in shape, horns, and in many other characteristics like the auerochs; but the color, almost universally black, does not agree. The Corsican race has retained the auerochs color and many of its traits of character, but the horns are too short. All of these types live in herds and have gregarious instincts.

The goal to be attained must combine the bodily shape of the Spanish fighting bull, the horns of the French, the wildness and activity of both, the color of the Corsican, the coat of hair and the manner of hair-shedding of all three.

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KEEPING BATS IN CAPTIVITY

WILLIAM H. GATES

During the summer of 1935, while on vacation in the Nantahala Mountains in western North Carolina, a few brown bats, *Eptesicus fuscus fuscus* (Beauvois), were captured. These at first were put into a large cardboard box, but later were removed to a large cage, measuring 24 x 18 x 48 inches. For one reason or another these bats escaped after having been in captivity for about two weeks. The idea suggested itself, however, that since none of them had died during this time, there might be a possibility of keeping individuals in captivity for a sufficient length of time to obtain some interesting information on their habits and reproductive activities.

On July 29, 1935, an adult pair of the same species was captured, and two days later a very young male also was caught. After a few days, during which all three lived together very peaceably, the adult male seemed to worry the female, and it was found necessary to separate them. Undoubtedly this teasing was due to mating activities, for the male showed every evidence of being at the height of sexual development.

These three individuals did well in captivity and were brought to Baton Rouge, Louisiana, on September 1. They continued to eat regularly and appeared in excellent condition until September 19, when, for no apparent reason, the adult male died. A post mortem showed a severe subcutaneous hemorrhage between the shoulders, which undoubtedly was the result of an injury and the probable cause of death. The male weighed 18.2 gms., having gained 2.5 gms. since September 2, and there was considerable internal fat. The young male died on September 18. In this case no cause for death could be ascertained.

The adult female continued in good condition until about January 10, 1936, when she began losing weight rapidly, and died January 15. Until January 4 her weight had remained above 17 gms., fluctuating according to hibernating conditions. She reached her maximum weight on October 19, when she weighed 19.1 gms. This bat thus lived in captivity for 170 days, during the first part of which time she had been active, but later she entered a semi-hibernating condition. Her weight throughout this period would indicate a normal, healthy condition.

Since that time other bats have been successfully kept in the laboratory for varying periods of time. A female Seminole bat (*Lasiurus seminola*) was kept from September 30 to December 3, 1935. She seemed to enjoy yeast, and so this frequently was mixed with her food. On the morning of December 3, she was found dead and bloated, blown up almost like a tiny toy balloon. Her weight had increased steadily until October 19, at which time she weighed 13.0 gms. After death she weighed 12.1 gms., and therefore must have been in good condition previously.

Mention might also be made of a female *Lasiurus borealis borealis* (Muller) which seemed to thrive in captivity and later died of an injury. On March 23, 1936, a specimen of *Corynorhinus macrotis* (LeConte) was brought into the laboratory. A little difficulty was experienced in getting this individual to eat. After several days, however, it began gaining and continued to do so until April 13, when it died, due to accidental exposure to heat.

The free-tailed bats, *Tadarida cynocephala* (LeConte) apparently do not thrive in captivity. They will eat nothing, drink little, and resent handling, apparently never becoming tame enough to be handled without resentment.

On December 4, there arrived a shipment of a few bats from Mr. Charles E. Mohr of the Reading Public Library, Reading, Pennsylvania, very kindly collected by him in Center and Mifflin Counties, Pennsylvania, on December 1, 1935. This shipment included specimens of *Eptesicus fuscus fuscus*, *Myotis lucifugus lucifugus*, *M. sodalis*, *M. subulatus leibii*, and *Pipistrellus subflavus*. Some of these were killed and given to the University Museum. Of the remainder, the females were placed in small cages, while the males all were put in one large cage. The first night all the males escaped through a crack made by a warping board. All the females, therefore, were isolated from the males on and after December 4.

Judging by the few individuals kept, the adaptability of the different species to captivity varies but little. Experience would indicate the following order of adaptability: *E. f. fuscus*, *M. sodalis*, *M. subulatus leibii*, *L. b. borealis*, *L. seminola*, *P. subflavus*, *M. l. lucifugus*, *C. macrotis*, *T. cynocephala*. There is but little difference between the various species with the exception of the last, which so far has not responded to captivity. Ease of taming also varies, but in this case *L. b. borealis* and *L. seminola* rank first, followed by *C. macrotis*, *E. f. fuscus*, *M. s. leibii*, *M. sodalis*, *M. l. lucifugus* and the untamable, *Tadarida*.

One major difficulty encountered is in the confining of bats to small quarters. If kept in cages too small in which to fly, they do not thrive; if the cages be of a size to permit flight, they frequently become injured. Several individuals have died from internal injuries, due probably to bruises.

FOOD.—A great variety of foods have been tried in the feeding of the bats, but, until recently, without any attempt to use any of their natural insect foods. At first, the standard diet employed consisted of bread, American cheese, and hard-boiled egg, all cut quite fine. To this was added a few drops of milk. This was varied at times by the addition of various kinds of vegetable or meats (except salted), both cut fine. Later it was found that all the bats liked banana also, and at times this was added to the regular diet. Still later it was found that sour milk and clabber are preferred to sweet milk, although evaporated milk is preferred to whole fresh milk. Cream (cottage) cheese is by far the first choice of artificial foods, and frequently the bats will select pieces of this and discard other food.

The regular diet used most of the time comprises bread or crackers, together with hard-boiled egg, cut fine, and moistened with a small quantity of cream cheese, buttermilk or milk. The above is standard, but may be varied by the addition of finely chopped meat, vegetables, banana, yeast, dry malted milk, ovaltine or even finely chopped nuts. The food should not be moist enough to be sticky, yet at the same time not dry, the ideal condition being a moist, crumbly mash. This food is rather highly concentrated, so care should be taken not to omit the bulky portion. It is best always to prepare the food fresh each evening as its moist condition causes it to sour and become unpalatable rather quickly.

Quite recently honey bees, killed and cut up, have been added to the diet with apparent beneficial results. This improves the consistency of the feces and adds to the palatability of the food. Other insects, such as grasshoppers and June beetles, have been tried, but the preference seems to be for bees, perhaps because the contained nectar provides a sweetish taste. Bats will eat a great variety of foods, both meats and vegetables, and actually seem to prefer a variety of different foods on successive days. Just what would be the effect of a standard diet over long periods is not known.

All foods must be in small pieces, for the bats have no way to break up large pieces of food. Water must be available, and is taken freely from relatively flat dishes. Food likewise should be given in shallow dishes, as the bats cannot easily reach into a high or deep dish.

The amount of food eaten varies to some degree, according to activity. Under ordinary active conditions the brown bats consume approximately 3.5 to 4 gms. of food per night, the red and Seminole bats about 3.0 to 3.5, and the different species of *Myotis* from 2.5 to 3.5 gms. All bats lose weight during the first week of captivity, before becoming accustomed to their new diet; following that, they soon regain their normal weight. Frequently, the

new diet causes a slight diarrhea, but this soon ceases and the feces appear normal, but perhaps a bit more moist than in the wild state, especially if insects are not added.

HIBERNATION.—The following are a few notes on the hibernation of bats under laboratory conditions made during the fall, winter and spring of 1935–1936. It must be remembered that in the south, where the climatic conditions are moderate, the laboratory temperatures are subject to considerable variation, varying sometimes from 70 degrees F. during the day and early in the evening, to 55 degrees by morning. The various species of bats differ but slightly in their habits, so that the following notes recorded for an adult female *E. f. fuscus* will serve to give some idea of how they react during late fall and winter in captivity in Louisiana.

September 14: Has eaten well and regularly every night. September 15, 16, 17: Food untouched, and position unchanged. September 18: Ate an extraordinary amount of food; in fact, cleaned up all food given by 9:00 P.M. Fed again and she nearly cleaned up again. September 19 to October 4: Ate regularly; weight on 27th, 17.5 gms. October 5 to 9: Food untouched every night, position little changed, no feces voided. October 10: Ate heartily again last night. October 10 to 27: Has eaten regularly and quite heartily; weight on 19th, 19.1 gms. October 28 to November 2: Food untouched, no feces voided, weight on 2nd, 18.0 gms. Note loss of weight following period of fasting. November 2 to 6: Ate regularly November 7, 8: Food untouched. November 8 to 14: Ate regularly. November 15 to 18: Food untouched. November 19: Ate heartily last night. November 20 to 27 Food untouched. November 28 to December 2: Ate regularly and heartily. December 3 to 5: Food untouched. December 6 to 13: Ate regularly. December 14, 15: Food untouched. December 16 to 26: Ate regularly. At this time observations ceased temporarily, to be continued later. Similar behavior of this and other bats, however, might have been recorded continuously until the middle of February.

Hibernation, or what may be called hibernation, therefore, under our laboratory conditions and when the bats are confined singly, consists of intervals of feeding followed by one or more days of abstinence. Practically no feces are voided during the latter periods; the bat moves but little and is mostly inert. The temperature of the room has some effect on behavior. Cold usually causes the bats to hibernate, and they usually are active only on relatively warm nights. Even during periods of moderate temperatures, however, there are many times when they are quite inert, and again the periods of activity and quiescence of different individuals are not always the same. This type of behavior continues until about the middle or the last of February, following which the bats seem to become more active, remain active, and eat regularly every night. Temperature has less effect on their activities after the middle of February, and a cold spell after March 1 fails to force them into quiescence.

REPRODUCTION.—The *E. fuscus* caught on July 29, 1935, died on January 15, 1936, and was autopsied after death. No evidence was found of any embryos in the uterus, nor were there obvious indications of reproductive activity. The one female *M. s. leibii* died on January 6, and on examination there was no evidence of embryos. On January 10 a *M. l. lucifugus* and a *M. sodalis* were killed and examined. No reproductive activity was evident. On January 25th two more, a *M. l. lucifugus* and a *M. sodalis*, were sacrificed and examined. Still no evidence of embryos was found. On February 10, one of the *M. l. lucifugus* died, having been in captivity and isolated since December 4, 1935. On examination two normal embryos were found, one in each horn of the uterus. These measured 0.8 and 0.9 mm. respectively in length. This is interesting for two reasons: first because of the fact that the female had been isolated from the male for 68 days; and second, because of the pair of embryos. It is generally accepted that *M. l. lucifugus* normally gives birth to but one young.

On the following day, February 11, two remaining *M. sodalis* and one *M. l. lucifugus* were killed. Both of the former contained one embryo each. These were mounted on slides in toto and measured, after mounting, 1.1 and 1.2 mm. respectively. The *M. l. lucifugus* contained one embryo. Reports of rate of growth of bat embryos are not available, and, therefore, there is no way to judge the age of these embryos. The numbers, of course, are small, but since none of the bats examined from January 6 to 25 had ovulated, it is reasonable to suppose that those examined February 10 and 11 likewise had not ovulated. Furthermore, since all four of the bats examined on February 10 and 11 contained embryos, it is hardly probable that by random selection these four bats were the only ones that had ovulated, and the others had not.

If the assumption be made that ovulation of these last four bats took place some time after January 25, then it is certain that fertilization must have occurred through sperm stored in the uterus or tubes prior to December 4 at least, since all the females were isolated from the males on that date. While there is no proof of the fact, it is quite evident that, from the size of the embryos, they probably could not be more than seven days old.

Unless there be a marked difference in the rate of growth of the *M. sodalis* and *M. lucifugus* embryos, which is hardly likely, ovulation in all four of these bats must have taken place within the space of few days. Dr. Mary Guthrie (1933) showed that ovulation may take place in bats after February 1, if they be brought from hibernation into a warm laboratory. Dr. Guthrie's report seems to indicate that ovulation following the bringing of bats into the laboratory does *not* occur before February or March, while normal ovulation occurs after the bats leave the caves in April. The present observations agree with Dr. Guthrie's, in that ovulation does not take place before February 1, even if the bats are in a warm laboratory. Dr. Guthrie indicates, however, that a spring copulation is necessary for fertilization. The observations here

reported show that ova may be fertilized by sperm stored in the female for at least two months. The conditions certainly are abnormal but indicate that sperms remain viable for as much as two months. One *E. f. fuscus* is being kept to see if she will produce living young.

On April 14, 1936, I received a second shipment of 13 bats, collected by Mr. Mohr on April 11. These were secured in the same localities as the first shipment and were of the same species. They consisted entirely of females. Mr. Mohr stated that at the time of collecting these bats "the colonies are all still quite dormant." One *M. sodalis*, two *M. l. lucifugus*, and one *M. s. leibii* were examined on arrival. One small embryo (less than 0.5 mm.) was found in the *M. sodalis*, but no evidence of any was observed in the others. A *M. l. lucifugus* was examined on April 22, eleven days after capture, and no evidence of any reproductive activity was observed. Again on April 28, a *M. sodalis* was examined with similar results. This lack of reproductive activity perhaps was not to be expected, but may be accounted for by the fact that these bats arrived in very poor condition, and it was rather remarkable that as many survived as did so.

On May 11, another *M. sodalis* was examined and found to contain one well developed embryo, measuring 8 mm. crown-rump length and with normal curvature. Here again fertilization occurred after nearly a month of isolation from the males. It is probable, from Mr. Mohr's statement, that no spring copulation had taken place, and therefore fertilization was by means of stored sperm.

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NOTES ON THE HABITS OF THE LONG-TAILED HARVEST MOUSE

By Clarence F. Smith

The following notes comprise the more important observations made during a study of the long-tailed harvest mouse (*Reithrodontomys megalotis longicaudus*) during the spring of 1935, while the writer was a graduate student at the Museum of Vertebrate Zoology, University of California, Berkeley, California. The writer desires to express his appreciation for advice and assistance received from Dr. Joseph Grinnell, Dr. E. Raymond Hall, and Mr. Lawrence V. Compton. He is indebted also to Mr. Gerrit S. Miller, Jr., and Dr. H. H. T. Jackson for permission to examine specimens in the National Museum and Biological Survey collections. The study was carried on in the field and in the laboratory. The area selected as typical of the habitat of this species in the vicinity of Berkeley is located just below the summit of Skyline Ridge, between Claremont Canyon and the head of Bancroft Way. (U. S. Geological Survey topographic map, Concord, California, quadrangle, 1897, edition of 1910.)

Nesting.—In the area under consideration, the harvest mouse inhabits either level or steeply sloping ground, and may be found in grass meadows or in fairly heavy chaparral of the *Artemisia-Baccharis* association. No nests were found in burrows, although two systems of burrows, into which harvest mice were traced, were excavated. No evidence was obtained to show whether the burrows actually were excavated by these mice, or by other rodents of the area. Two nests were found upon the surface of the ground: one under a board in a grassy meadow, and the other under a *Baccharis* plant. Both were constructed of plant fiber and "cotton", the latter probably from the seeds of *Baccharis*, they were well-woven structures about three inches in diameter, and were semi-globular in shape. The single opening of each was about one-half inch in diameter and was lined with the material that lined the interior of the nest. The cup of the nest was about the diameter of a golf ball, and the outer portion consisted of a woven mass of plant fiber.

In the laboratory, plentiful supplies of cotton and plant fiber were available to the mice, but only the cotton was used. Some of the mice showed highly developed acquisitive instincts, and stole material from adjoining cages even when there was a plentiful supply of their own. In one case, two mice occupying adjoining cages, separated only by one-quarter inch mesh screen, carried on a thieving duel for several days. Both mice built their nests in adjacent corners, and during this time the material, weighing about 7 ounces, was pulled through the screen 18 times before the investigator finally removed the nests to opposite corners.

Nests were removed from cages upon several occasions, with the result that the mice attempted to find a hiding place by burrowing into the sawdust and shavings covering the floors of the cages. No attempt to use the forepaws was noticed, but instead the digging was done by rooting with the snout.

When more than one mouse occupied a cage, the same nest was used by both. This tolerance even permitted the introduction of a strange mouse into a cage which the other mouse already had occupied for several weeks, and the placing of individuals in a cage entirely new to both. No apparent difference existed with regard to the treatment of one sex by the other. None of the mice seemed to resent to the slightest extent inva-

sion by a strange mouse, and both always would be found together inside the nest. Even at the time of the birth of young, the mother tolerated not only her mate, but a completely strange male, in the same nest with the babies.

The process of nest construction was commenced with the accumulation of bits of cotton which were pulled in and up to form the sides, roof, and floor, all at the same time. After the cup was formed into a closed sphere, enlargement was accomplished by pulling bits of cotton into the nest, patting them into position with the forepaws, and where resistance was met, with the teeth. These operations were accompanied by continual turnings of the body. The construction of a nest, when uninterrupted, occupied about 15 minutes in the laboratory where the material for construction was immediately available.

Home instinct was noticed in the laboratory, where it was learned that an escaped animal used regularly to sleep in a tin can filled with cotton.

Reproduction.—One pair of mice bred under laboratory conditions, but no observations were made upon mating activities. The mice showed no apparent change in their attitude toward each other, and a strange male, placed in the cage just 12 hours prior to the birth of the young, was at once accepted by the mated pair, and the next morning was found in the nest together with the parents and young.

The mated pair were placed together on February 9, after they had shown their interest in one another by leaving their respective nests and going to the screen which separated their cages, where they rested.

At 9.30 A.M. on May 2, two babies were found in the nest, together with the parents and the strange male. The mother had shown no external signs of pregnancy when closely examined on April 30. At 10.19 A.M., only the two young were present, but a third was born between that time and 10.22, when the mother was licking the third baby. The umbilical cord still was attached to the latest arrival.

At birth the young are quite helpless; the eyes and ears are closed and they cannot lift their heads. The vibrissae are the sole hair structures visible at birth, and are quite well developed and functional. The voice at this time is a shrill insistent screech, partially audible to the investigator as sound, and partly as an impact upon the ear drum. The skin is perfectly smooth and quite pink with a membrane-like appearance. The length of the body at birth, measured in the curled position, was 21 mm.

The following dated notes show the sequence of development from birth until the young were weaned:

May 3.—The skin had become noticeably darker and more wrinkled, and the voice was slightly lower in pitch. The effect of impact upon the ear drum, so noticeable 24 hours earlier, now was not apparent. The young spent most of their time fastened to the mother's nipples, all of which appeared to be functional, but the mother left the babies in the nest when she emerged.

May 4.—The ear pinnae were open, although the auditory meatus remained closed. The abdomen remained pink, but the other skin areas had become bluish in color. The young were beginning to crawl.

May 5.—The call of the young now consisted of about seven syllables decreasing in volume. The eyelids now showed a line at their juncture, and close examination of the body revealed the faintest traces of hair. The skin, except for the abdomen, was nearly black.

May 6.—The first signs of the mandibular incisors appeared. At this age, the babies are able to stand, although they do not walk. The mode of progression is with the forefeet working alternately and the hind feet working together. Coloration of the hair was first noticeable. Hair on the tail first appeared, although the abdomen is still bare, and only the back and sides show much hair.

May 11.—The babies began to walk at about this time, with the hind feet functioning alternately. The auditory meatus was open for the first time, and there was a noticeable reaction to squeaks, which caused the young to contract their bodies as much as possible. The use of the tail as a balancing organ at this early stage of walking was quite pronounced. A rufous-colored area of hair was beginning to show at the posterior margin of the vibrissae, and a similar area at the auditory opening.

May 12.—The eyes first opened, but apparently were of little use for another 48 hours. Until this time the young showed no resistance to the mother when she picked them up, but now they struggled when she attempted to pick them up in her mouth.

The babies were fully weaned at about three weeks of age. Their weight at birth was 1.2 grams in two individuals, and 1.0 gram in the third. The growth curve, as outlined by weight and length measurements, shows that growth is not apparent until 24 hours after birth, after which it is even and constant. Comparison of the two curves shows that minor fluctuations occur in inverse ratio.

The young mice consistently were much wilder from the first than the adults and required to be handled with great care to prevent their escape.

Breeding season.—Statistical analysis of breeding data accompanying skins in the Museum of Vertebrate Zoology sheds some light upon the duration of the breeding season. There were examined 304 females, all, with one exception (from Jackson County, Oregon) from 35 California counties, representing the entire range in California of this subspecies. Pregnant females occurred in all months of the year except January and March, and they indicate the existence of two important breeding seasons. One occurs in April, and a less important one in October.

The accompanying chart shows the numbers of females recorded for each month, and indicates the pregnancy percentage of each monthly total. Although only 6 specimens are recorded in August, and 8 in February, the remainder of the collection is sufficiently representative to be of significance. Only a single pregnant female was recorded in three of the months, February, August, and December. Only 2 pregnant animals were reported in September, 5 in June, 6 in November, 7 each in July and October, 10 in May, and 14 in April.

Food Habits.—Owing to the low level of *Reithrodontomys* population over the period covered by these investigations, very limited numbers of animals were taken, and as most of these were kept alive for laboratory examinations, only two stomach examinations were made. One of these, taken March 30, contained seeds and bits of stems of the grass genera *Festuca*, *Bromus*, and *Avena*. The stomach of the second mouse, taken March 31, held seeds and bits of stem and leaves of *Astragalus*, *Festuca*, and *Bromus*. In addition to these items both stomachs held a certain amount of plant food indistinguishable except as pulp.

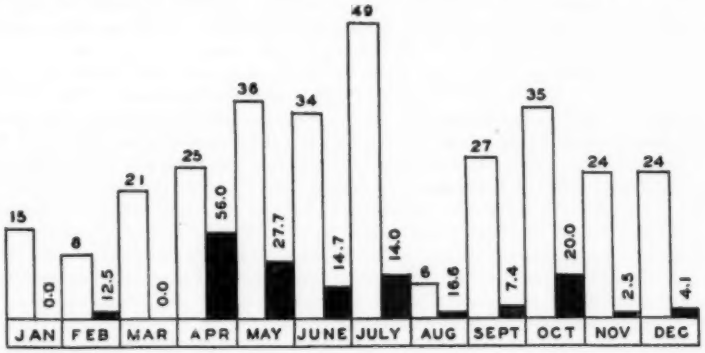
Laboratory investigation of food preferences was made by offering, to captive wild mice, plants taken from the localities in which the mice were trapped. These items included most of the plants found in the immediate vicinity of the trapping sites, and represent an area of about 2,500 square feet of sage-chaparral flora.

Plants accepted and eaten	*Plants not eaten*
Avena fatua—wild oats	*Artemisia tridentata*—sagebrush
Bromus sp.—brome grass	*Eschscholtzia californica*—California poppy
Hordeum murinum—foxtail	*Baccharis pilularis*—coyote brush
Erodium moschatum—white-stem filaree	
Medicago hispida—burr clover	

The mice ate only the green portions of these plants, and made no attempt to utilize the woody parts or roots.

All evidence concerning the supposed habit of hoarding was negative. In none of the excavated burrows were there found any signs of storage, although at the same time *Microtus* burrows in the immediate vicinity regularly contained stored food. None of the laboratory animals showed any desire to accumulate reserve food, except for two or three isolated instances in which a single item of food was buried. The mice were consistent in this respect, and no individual showed any marked difference from any other. Only in a single case was a mouse seen to dig up a buried food item.

The mice showed a decided reaction to living moths (*Autografa californica*) placed in the cage. This moth is common in the region, and has a wing-spread of about two inches. The body is thick and short. The moths apparently were recognized as food, although in some cases the mouse showed uncertainty regarding the method of procedure. Before attacking, the mouse first crouched motionless with attention riveted upon the moth for a few seconds. Then it made a quick dash, seized the moth, and in a tussle lasting about a second, killed its prey and gulped down the soft parts, leaving only the wings, legs, and one or two other hard parts. The mouse sometimes varied the at-



INCIDENCE OF PREGNANCY IN *Reithrodontomys*

Open blocks show total number of females captured in each month. Solid blocks show percentage of pregnant females in each month.

tack by making a short preliminary stalk, exactly in the manner of a cat stalking a bird. The rapidity with which the moth was eaten contrasted in a high degree with the leisurely manner of eating inanimate food. No interest was shown in moths unless they were alive, and dead moths left in cages overnight invariably remained untouched. The moths seemed at times to be able to hold their own, as not always did the attacks end in victory for the mouse. On these occasions the mouse made no second attempt to attack the moth, and showed no further interest in it.

Cannibalism was not practiced, so far as laboratory evidence indicated, and all individuals lived together amicably, as mentioned above. Individuals of *Peromyscus truei gilberti* and *P. maniculatus gambeli* also were accepted by *Reithrodontomys* exactly as they accepted others of their own species, and the mice walked over and under each other with neither showing the slightest sign of resentment. This reaction lasted for periods of at least 24 hours, beyond which time experiments were not continued.

Laboratory diet was based upon two balanced rations in common use at the University of California, supplemented by fresh plant food, and by rolled oats and water.

The use of green food made little apparent difference in the amount of water used. The mice drank frequently, and usually finished a meal by washing face and paws, grooming themselves, and then by drinking. The free moisture in the food offered, and metabolic water, was sufficient to meet the needs of the mice, and one individual had no other source of water for over a month. This mouse apparently had no desire for moisture, as it showed no interest in water placed just out of reach.

The average per capita consumption of oats by eight mice for an eleven-day period was 1.63 (1.46–2.32) grams per day. During this period, fresh plant food twice was supplied, and an average of 3.0 grams for each two-day period was eaten. Volumetric estimates of the amount of water consumed were not made, but the approximate consumption is six to eight drops per day.

The passage of food through the digestive tract requires approximately 24 hours, as indicated by the change in color of the feces from light brown to greenish-black.

The favorite time for feeding seemed to be after sundown, whether or not the laboratory was lighted. During the first few days of captivity, the mice were not seen, except for a single individual that emerged several times from its nest in daylight. After a week or so of captivity, the mice emerged during the daytime, or when the room was lighted at night, almost as readily as in complete darkness. Under normal conditions in the field no evidence of daylight activity was found.

Some individuals ate at the spot where the food was found, while others went to the "feeding-ground," took a bit of food, and retired inside the nest to eat. This difference was constant with the individual, and may have been caused by the light. Following a meal, the mice invariably stretched, yawned, and proceeded to wash and groom their fur. Each individual had regular times for feeding, and in general it seemed that each made a periodic meal of five to ten minutes duration between sundown and 10.00 P.M. Although food was taken at the last-mentioned time with a high degree of regularity, any of the mice might appear for a minute or two at almost any time of day and partake of a short meal. Between midnight and 8.00 A.M. some feeding was done, and there may have been additional periodic meals, but observations between these hours are too meager to be of significance. One individual never was seen outside the nest at any time, and always fed during this period of quiet.

Other observations.—The harvest mouse does not become gentle, and dislikes handling even when not alarmed. The mice used in my experiments were handled nearly every day, and only one or two of them ever became gentle enough to permit them safely to remain free outside their cages. One of these would sit in my palm for a moment or two, then walk to the edge of my hand, seek for some easy means of getting into the cage, and would then jump into its cage. When my hand was raised more than three or four inches above the floor or sides of the cage to which the mouse might jump, this animal several times deliberately sunk its teeth into my skin and tried to chew my finger. Then, it again looked to see if the cage were nearer; if so, the mouse jumped into the cage, but if not, it again tried to bite me. All during this time, the mouse was quite free to move exactly as it wished. As long as my hand was in motion, no attempt to jump was made, but when the hand became still, the mouse began to seek a means of escape.

This behavior was in decided contrast to that of *Peromyscus*, which could be handled with impunity almost immediately after capture. The deer mouse often will be tame enough to feed upon the hand within 24 hours after capture, and I never have had even an alarmed *Peromyscus* attempt to bite me.

The young mice, raised in the laboratory and handled at least once daily, were wilder even than the parents, and objected frantically to capture. All the *Reithrodontomys* remained quiet enough when actually captured, but watched alertly for, and took every chance, to escape from my grasp.

U. S. Biological Survey, Washington, D. C.

A NEW BEAVER FROM THE PLIOCENE OF ARIZONA WITH NOTES ON THE SPECIES OF DIPOIDES

By R. A. Stirton

Among some fossil vertebrates recently presented to the Museum of Paleontology, University of California, are the remains of a new beaver. Other specimens found at the same locality are limb-bone fragments of a hystricomorph rodent, an upper molar, calcaneum, and part of an incisor of a rabbit, the proximal end of a femur of a smaller rodent, the distal end of a bird scapula, and amphibian and fish bones.

This material was found by Dr. Howel Williams of the Geology Department, in freshwater tuffaceous sediments at White Cone, Hopi County, Arizona. More explicitly the specimens were found 15 to 25 feet above the coarse tuff band (4 feet thick) which forms a terrace 60 feet above the base of White Cone. This locality is approximately 47 miles north of Holbrook.

The drawings were made by Owen J. Poe.

Dipoides williamsi, new species

Type.—Fragmentary left lower jaw with P_4-M_2 in place, alveolus for M_3, distal end of incisor broken off, ascending ramus missing and lower outline of jaw broken away. No. 32764, Univ. Calif. Mus. Pal.

Paratypes.—Right upper molar and right lower molar. Nos. 32765 and 32766, Univ. Calif. Mus. Pal.

Age.—Middle Pliocene.

Specific Diagnosis.—Extreme hypsodont cheek-teeth; no parastria (for dental terminology see Stirton, 1935) on upper molar; no parastriid on P_4; lower molars much narrower anteriorly than posteriorly; S-pattern on P_4, M_{1-2} and upper molar.

Dipoides williamsi is one-sixth smaller than *D. stirtoni* Wilson (1935) from the Rome and Rattlesnake faunas of Oregon. The new species differs from the Oregon species in the absence of a parastriid on P_4. Furthermore, the cheek-teeth are more triangular than rectangular in outline. *D. williamsi* agrees with *D. stirtoni* in having an S-patterned upper molar, although Wilson directed attention to variation in *D. stirtoni* in which small parafossettes and metafossettes are present. The persistency of the S-pattern on *D. williamsi* cannot be determined until more specimens are found.

The type of *D. sigmodus* (Gervais) possesses a P_4 with an S-pattern, but this differs from *D. williamsi* in having a minute parafossettid on the premolar. The Arizona species differs further from the French type in having molars with an occlusal outline that is more triangular than rectangular.

The lower molars in the type of *D. major* Schlosser also are like those of *D. stirtoni* and *D. sigmodus*, and differ from those of *D. williamsi* in their more rectangular occlusal outline. The disassociated teeth from Olan Chorea, Mongolia, which were referred to *D. major* by Schlosser (1924), show some resemblance to *D. williamsi* in the S-shaped upper molars and in one S-shaped P_4 (Pl. II, fig. 30). It is interesting to note that the upper premolars referred to *D. major* by Schlosser and those in a skull described by Young (1927) from Paote, west Shansi, China, are S-shaped. Unfortunately this tooth is not represented in the material from White Cone.

The genotype, *D. problematicus* Schlosser, differs from *D. williamsi* in the possession of a parastria on the upper molars and a parastriid on P_4; and the occlusal outline of the lower molars is nearly square, according to Schlosser's figures.

A fragment of a lower jaw from the Upper Snake Creek (Stirton, 1935, fig. 129) probably is referable or closely related to the new species from White Cone. The only tooth preserved in the Nebraska specimen is a P_4. This tooth possesses an S-pattern and the occlusal outline converges to an apex anteriorly, but is about one-fifth smaller than in *D. williamsi*.

The absence of a parafossettid on P_4 makes it difficult to derive *D. williamsi* from any of the known species of the Lower Pliocene *Eucastor*, although some species, apparently,

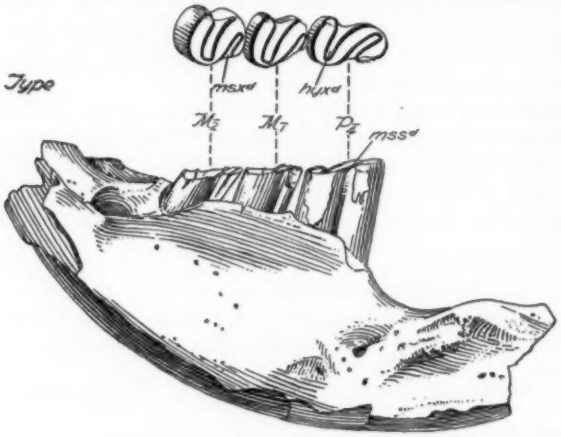
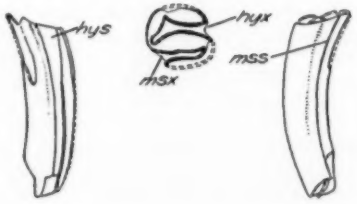


FIG. 1. *Dipoides williamsi*, type, lingual and occlusal views of fragmentary left lower jaw, twice natural size; *mss^d, mesostriid; msx^d, mesoflexid; hys^d, hypostriid; hyx^d, hypoflexid.*



a b c

FIG. 2. *Dipoides williamsi*, paratype, a-lingual, b-occlusal and c-labial views of right upper molar, twice natural size; *mss, mesostria; msx, mesoflexus; hys, hypostria; hyx, hypoflexus.*

are near the line of descent. In all of the species an S-pattern, of course, is developed at certain stages of wear on the upper and lower molars, and the species of *E. lecontei*, *E. tortus*, as well as some of the individuals of *E. planus*, have lost the metafossettid on P_4. But the parafossettid continues to the base of the tooth in all of the species that I have examined and there is no trace of this structure in *D. williamsi*. It might be logical, then, to assume that *D. williamsi* evolved from some unknown species of *Eucastor* with a reduced parafossettid.

The castoroid characters displayed in *D. williamsi* are: (1) The base of the incisor is external to the coronoid process; (2) The symphyseal region is nearly identical with that in *Dipoides stirtoni;* and there is marked similarity with the teeth of *Eucastor* and *Dipoides.*

MEASUREMENTS

	mm.
Length of tooth row P_4-M_3 alveolar border	21.8
Length of P_4 at alveolar border	5.6
Width of P_4 at alveolar border	3.7
Length of M_1 at alveolar border	4.0
Width of M_1 at alveolar border	4.0
Length of M_2 at alveolar border	4.0
Width of M_2 at alveolar border	3.8
Width of incisor	4.8
Length of upper molar	3.7
Width of upper molar	4.7
Height of P_4	approximately 16.0

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GENERAL NOTES

THE NUMBER OF FORMS OF RECENT MAMMALS

In 1926 I published (Jour. Mamm., vol. 7, p. 134, 1926) the number of genera and subgenera, species and subspecies of recent mammals described since Trouessart's Catalogus (1898). During the period from 1898 to 1924 inclusive there were described: New genera and subgenera, 425; fossil species and subspecies belonging to living genera, 262, and living species and subspecies, 8117.

I now have brought the list of additions up to date as of December, 1934. It stands as follows (1898–1934 inclusive):

	NEW GENERA AND SUBGENERA	FOSSIL SPECIES AND SUBSPECIES BELONGING TO LIVING GENERA	LIVING SPECIES AND SUBSPECIES
Monotremata	1	—	11
Marsupialia	43	5	355
Dermoptera	2	—	18
Insectivora	39	31	736
Chiroptera	50	15	1,086
Carnivora	41	131	1,272
Pinnipedia	—	4	22
Lemuroidea	1	—	61
Anthropoidea	18	17	499
Rodentia (sciurine)	41	36	1,222
Rodentia (murine)	168	97	2,769
Rodentia (miscellaneous)	38	26	475
Lagomorpha	10	18	305
Edentata	6	7	57
Artiodactyla	38	168	889
Perissodactyla	3	79	140
Cetacea	12	7	22
Proboscidea	—	27	15
Hyracoidea	—	2	87
Totals	511	670	10,041

This work has been done as part of the daily routine of the Division of Mammals, U. S. National Museum, and it gives a fairly complete idea of the systematic work accomplished during the past 36 years. No less than 10,041 new forms of living mammals have been described during the period intervening between Trouessart's list and the end of the year 1934. By adding to these the 4,423 (by actual count) listed in the Catalogus, we have a total of 14,464, a number which probably is not far from a correct summary of the forms of living mammals recognized at the end of 1934.—ARTHUR J. POOLE, *U. S. National Museum, Washington, D. C.*

HEAT RADIATION OF DOMESTIC ANIMALS DURING SEVERE COLD WEATHER

During a period of severe subzero weather on February 7, 1936, at Bozeman, Montana, there was raised a question concerning the ease with which animals withstood extreme cold. With an air temperature of −25.6°F., when people muffled themselves to the eyes, dogs were scampering around as though it were a summer day, and horses and cattle in

farmyards did not appear to be seriously inconvenienced. With the idea of gaining some information regarding the surface temperatures and heat radiation of animals under such conditions, the writers made the observations given herewith. Temperatures were taken with thermocouples and registered on a General Electric potentiometer. The experimental animals, a horse, and a mixed-breed ewe with coarse wool, were examined through the courtesy of Dr. Hadleigh Marsh. They had been outdoors continuously for several days prior to and during these observations. The data obtained are as follows:

HORSE

	°F.
Air temperature	−25.6
Body temperature.—Rectal	100.4
Rump.—Hair covering 5 cm. thick: Skin temperature	60.4
2.5 cm. distant from skin—half way through hair covering	27.5
5 cm. distant from skin—at end of hairs	−0.4
Flank.—Hair covering 7 cm. thick: Skin temperature	69.1
3.5 cm. distant from skin—half way through hair covering	37.4
7.0 cm. distant from skin—at end of hairs	−21.1
Back.—Hair covering 1.5 cm. thick, encrusted with snow: Skin temperature	36.0
0.8 cm. distant from skin—halfway through hair covering	10.4
1.5 cm. distant from skin—at end of hairs	−9.4
Middle of face.—Hair covering 0.5 cm. thick: Skin temperature	14.4
0.5 cm. distant from skin—at end of hairs	−11.2
Ear.—Skin of tip of ear	8.6
0.3 cm. from skin—at tip of hairs	−4.0
Inside of ear	23.0

SHEEP

Air temperature	−25.6
Rump.—Skin temperature	77.0
2.6 cm. distant from skin—halfway through wool covering	16.2
5.5 cm. distant from skin—at end of wool fibers	10.4
Right thoracic region.—Skin temperature	67.5
2.6 cm. distant from skin—halfway through wool covering	24.2
5.5 cm. distant from skin—at end of wool	10.4
Middle of face.—Skin temperature	12.2
0.2 cm. distant from skin—at tip of hairs	3.6

G. Allen Mail and Harlow B. Mills, *Agricultural Experiment Station, Montana State College, Bozeman, Montana.*

A HUMANE METHOD OF KILLING MAMMALS

For years the National Humane Association and many individuals have been studying methods of killing animals painlessly and many cities now maintain highly perfected lethal chambers for disposing of stray cats and dogs by means of carbon monoxide gas. This very deadly gas has the advantage of being almost odorless, neither explosive nor inflammable, and of causing death quickly without suffering. In fact the animals seem unaware of its presence and soon become unconscious. The only danger is to human beings who handle the gas and who are just as susceptible to its effects as are the animals. Great care must be used not to inhale much of the gas nor to remain where it is present in any considerable amount. The number of people who are killed by fumes from automobile engines left running in closed garages is an evidence of this danger.

A simple method of administering this gas to animals may prove useful, and with proper care it is perfectly safe and satisfactory.

Recently a red fox taken in a modern humane trap and uninjured in any way was needed for a scientific specimen. It was taken from the trap, placed in a loosely woven gunny-sack and carried comfortably to the automobile. The sack containing the fox then was placed in another large sack of heavy brown paper. In turn the mouth of the paper sack was drawn together, placed over the exhaust pipe at the rear of the automobile, and held in this position. The engine then was started and in a few moments the paper bag was filled with the deadly monoxide gas. The bag was quickly removed, the opening crushed tightly together, and the bag carried some two rods from the car, where it was tied securely with a stout cord. It is an easy matter to hold one's breath long enough for the whole operation and to avoid inhaling until well away from the car.

The fox made no sound nor struggle, and seemed not to be conscious of any discomfort. In three minutes it was relaxed, although still breathing, and in five minutes apparently was dead. It was left in the sack for eleven minutes to make sure that it would not revive and then was removed. It made a perfect skin, skull, and skeleton for the National Museum collection, and afforded good material for the study of parasites and parasitic diseases.

The method is so simple and easy that it could well be applied in the case of any small mammals that have to be killed, the sick or injured, or those required for specimens.—VERNON BAILEY, *1884 Kalorama Road, Washington, D. C.*

CRYPTOTIS PARVA IN WESTERN NEW YORK

Very few records of *Cryptotis parva* have been published from New York State (see Hamilton, W. J., Jr., Habits of *Cryptotis parva* in New York. Jour. Mamm., vol. 15, pp. 154–155, 1934) and until the fall of 1935, none had been reported from western New York. On November 24, however, Charles E. Simmons, staff photographer at the Buffalo Museum of Science, captured one of these shrews at Elma, Erie County. His attention was directed to it by the unusual actions of his dog, and he brought it to the museum where it was identified by Dr. Carlos E. Cummings, the director. On January 1, 1936, Everett R. Burmaster captured one near some outbuildings at Irving, Chautauqua County. On January 16, Jack Kraft brought us a live specimen that was hiding under a pasteboard box in his orchard at Eden, Erie County. This individual was kept alive and on exhibition at the museum. Within the hour after it was received it consumed 21 meal worms, 2 beetles (*Tenebrio molitor*), and a cockroach, thus upholding its reputation as a glutton. On January 17, Michael Statler captured one in the garage of a neighbor at Depew, Erie County. On January 20, John Mead caught another in the basement of his home at East Aurora, and on February 3, Charles L. Higgins, also of East Aurora, sent us one that had been captured by a cat.

A news story was sent to one of the Buffalo daily papers about the discovery of the little short-tailed shrew, and this resulted in one additional record, although the specimen was not sent in. This was from Forestville, Chautauqua County. Mr. Roscoe B. Martin, a keen observer, recalled, on seeing the picture and the description in the paper, that his cat had toyed with one in October. He had been curious enough to observe it, and was quite sure, after talking with the writer, that the specimen was *Cryptotis parva*.

I observed one of the little creatures at West Hamburg, Erie County, in the fall of 1931, having been attracted by the actions of a cat that was playing with it. The cat reached out and batted it gently with a paw, whereupon the shrew leaped at the cat with wide open mouth. Sometimes it leaped directly into the face of the cat. This display of courage touched the writer's heart, and he rescued the creature, but it proved to have been injured so severely that it had to be killed. At the time I was not familiar with the

smaller mammals of New York State, so I dismissed this occurrence with no further notice. Now, however, after having handled all the specimens brought to the museum during the last few months, I have no doubt that the cat had a specimen of *Cryptotis parva*.—C. Bernard Peterson, *Buffalo Museum of Science, Buffalo, New York.*

THE SHORT-TAILED SHREW AS A TREE CLIMBER

On Sunday, December 15, 1935, I was surprised to find a large specimen of short-tailed shrew (*Blarina brevicauda brevicauda*) eagerly devouring suet that I had placed in a suet basket nailed to a tree about 6 feet from the ground. This basket was one of several I had placed for the purpose of attracting birds to my property near Boonton, New Jersey. I had noticed that this basket needed replenishing more often than any of the others, although it appeared to be the least frequented by the birds.

On this particular morning I made my rounds shortly after daylight and found the shrew busily engaged. He took no notice of me until I was about 6 feet away, when he sensed my presence. At first he remained quiet, but upon my nearer approach he made one or two unsuccessful attempts to push his way through the wire screening. He then climbed to the top of the basket and went through a hole in the cover next to the tree trunk. As he was pushing his way through this hole I caught him, but later released him in the basket. He ran immediately to the hole, squeezed himself through and ran down the trunk and into a hole at the base of the tree. The tree was a red oak about 8 inches in diameter and was leaning at a very slight angle. The surprising feature was that on his trip down the tree he did not keep entirely on the upper side of the trunk, but went on a diagonal course, finishing his journey on the under side.—T. D. Carter, *American Museum of Natural History, New York City.*

DESERT PALLID BATS CAUGHT IN MOUSE TRAPS

During the first week of August, 1932, while collecting mammals for the San Diego Society of Natural History, S. G. Harter and the writer were camping at Pellisier Ranch, 5600 feet altitude, 5 miles north of Benton Station, Mono County, California. It was our habit to look over the traps by lantern light about 10:30 each evening. We cleared our lines as usual about this time on the night of August 1, destroying many of the insects, chief of which were pinacate beetles and desert crickets, which were attracted to our traps by the bait. On this round we obtained a fair number of pocket mice and kangaroo rats, but nothing unusual was found.

Our surprise may be imagined when at daybreak the following morning, 2 specimens of the desert pallid bat (*Antrozous pallidus pallidus*) were found in the traps. Both bats had been caught in places free from vegetation, and it appeared certain that they had been feeding on the insects that had been attracted to the traps.

Many naturalists have speculated regarding the feeding habits of bats. Hilda Wood Grinnell (Univ. Calif. Publ. Zool., vol. 17, p. 356, 1918) inferred, and A. B. Howell (Jour. Mamm., vol. 1, p. 175, 1919) repeated that bats of the genus *Antrozous* are ground feeders. Mrs. Grinnell's basis for this statement seems to need no verification, for the prey of the bats she studied were Jerusalem crickets, which are incapable of flight. She did incline to the belief, however, that the keen sense of hearing of the bat was the principal means of detecting such prey, and in support of this contention she cited the fact that Jerusalem crickets make a slight noise when walking.

There existed a somewhat similar situation in the case here discussed. Our mouse-trap bats, however, suggest that the prey may have been located by sight rather than by hearing, for the feeding insects could have been making no appreciable noise.

I have experimented with *Antrozous* and found that it is possible for them to fly up from the floor of a room, but only with great difficulty. It thus seems unquestionable

that these two bats were in flight when caught by the traps.—Laurence M. Huey, *San Diego Society of Natural History, Balboa Park, San Diego, Calif.*

A WEASEL LEARNS BY EXPERIENCE

The following events occurred on the shores of Burntside Lake, near Ely, Minnesota, where I was spending the winter. On January 7, 1936, a trapper friend of mine noted weasel tracks around a huge rock pile pierced by endlessly ramifying crevices and passages. That afternoon he carefully set a number 1 steel trap, baited with a piece of fresh snowshoe rabbit, and on the morning of January 8, he brought me a fine male specimen of the Bonaparte weasel (*Mustela cicognanii cicognanii*), caught high up on the hind leg and uninjured. I released it in a large wooden box having a screened top, with a hinged board through which food and water could be introduced. The first day the little white creature was very timid and refused all food. The second night it ate several pieces of rabbit. The third day the weasel was much less timid, sniffed curiously at one's finger, and ate well. The fourth day it was quite tame and seemed entirely contented. The fourth night, January 11, it managed to escape from the box by manipulating the hinged board. The following morning its absence was discovered, and an inspection of the surrounding snow showed that it had escaped from the cabin by squeezing through a hole by a pipe. I followed the tracks immediately. They rounded the cabin, turned at a right angle, passed through a wood, crossed an arm of Burntside Lake in a straight line to the wooded shore beyond, and from there headed straight for the home rock-pile two miles away. There was absolutely no uncertainty shown en route; that weasel knew where it was going, and went there. Since I wanted it for a specimen, the trick was to catch it again, and my trapper friend went to work.

Then began a battle of wits between the weasel and the art of a skilled trapper. On the first night three steel traps were set and baited with rabbit. One was under a rock pile; two were in open woods. The next morning the tracks showed that the weasel had come straight to the rock-pile set, approached to within 6 inches of the hidden trap, and stopped; turned around; circled the little heap of stones; found that it could not approach the bait from any other point; then departed. The tracks wandered around; the weasel caught a mouse and ate part of it; then wandered farther. Suddenly the tracks turned at a sharp angle and headed 40 yards to one of the woods sets. It came straight at the hidden trap; stopped; circled, and then began to scratch and dig under the pile of snow-covered brush that supposedly prevented a rear approach to the rabbit; took the bait, ate it on the spot, and then returned to the rock pile. The next night the same thing happened to the third set. Between January 11 and February 1, that particular weasel avoided 27 set traps and succeeded in stealing the rabbit bait from 13 of them. Of the 14 remaining traps it approached 9, only to discover that there was but one possible way to the rabbit, and this it wisely refused to take; the other 5 never were discovered.

On February 1, all traps were taken up and a fresh start was made. This time we used but one rabbit bait, placed with one obvious approach, in which a trap was set. In addition, several less obvious approaches were arranged, and each of these was guarded by a well-hidden trap. When we left, there were 5 traps around that bait. On the morning of February 2 we found the weasel dead in one of them. The tracks were interesting. They showed that the weasel had approached the obvious entrance; stopped; circled the bait; approached three of the more likely possibilities in turn; stopped at each; circled some more; and finally was caught by the trap guarding the most inaccessible, although possible, approach. Whereas the weasel had walked without hesitation straight into the first trap, it took 21 days and 32 set traps to catch it a second time.—A. R. Cahn, *Tennessee Valley Authority, Knoxville, Tennessee.*

SEX RATIO AND SIZE VARIATION IN SOUTH DAKOTA MINK

Recently, in looking over some old notes from Brookings and Windsor counties, South Dakota, I found some sex ratio, size, and other data pertaining to 68 mink (*Mustela vison*), these being largely animals which I had trapped for fur during 6 winters from 1919 to 1927. Of this lot, 38 were males and 30 were females, or at the proportion per 100 of 56:44. There is reason to believe that this ratio is rather representative for the locality during the pre-drought years. I doubt that the trapping technique used was more selective for one sex than for the other.

The measurements recorded in my notes refer to the total length, to the nearest inch, of freshly, conservatively stretched pelts. The conspicuous differences in average length of pelts taken in the vicinity of the Sioux River, west of Brookings, and of those from the Oakwood Lakes, 10 to 15 miles distant, substantiate a tradition among local trappers to the effect that lake mink as a rule are larger than river mink.

Pelts of 24 lake males averaged 35.9 inches in length (32 to 39), and the pelts of 15 river males averaged 3 inches less, or 32.9 inches (26 to 35). The lake females were almost as large as the river males, 15 pelts averaging 31.3 inches (29 to 34), compared with 26.9 inches average (18 to 32) for river females. Median lengths: lake males, 36 inches; river males, 34 inches; lake females, 32 inches; river females, 28 inches.—PAUL L. ERRINGTON, *Iowa State College, Ames, Iowa.*

DEHAIRING OF CATERPILLARS BY SKUNKS

Some years ago my friend, Dr. H. H. Knight, told me of his observation of a striking habit observed in a half-grown pet skunk at Ithaca, New York. When offered a woolly caterpillar, such as the familiar brown and black isabella, the skunk rolled it on the ground with one or both front paws until all the hairs were rubbed off, whereupon the naked body of the caterpillar was devoured. This was reported by him in Nature Study Review (vol. 13, p. 93, 1917).

Two skunks of a hand-raised litter recently obtained from Mr. Robert Clow in Wheatland Township, Will County, Illinois, performed this rolling trick when first presented with a woolly caterpillar. The rolling is done with just sufficient pressure to remove the hairs without crushing the creature. When these individuals were half-grown, they were loaned to a nature study class in the Evanston schools, where their invariable performance of this caterpillar-rolling act created so much interest that scores of caterpillars were brought by the children to school to be fed to the skunks. This feeding habit thus certainly is not accidental nor individual. The usefulness to the skunk of this act is evident from the well-known irritating nature of caterpillar hairs. From the fact that these skunks were raised from their blind infancy without a mother it may be inferred that this is a genuinely instinctive behaviorism. I do not believe that they became conspicuously more expert at caterpillar-rolling after repeated trials.

Doctor Knight's skunk was reported as employing a similar procedure when offered toads. A toad was rolled in the dirt with sufficient force to cause it to exude its skin poison. After brushing and shaking its victim to remove the dirt, which had absorbed the poison, the skunk ate the toad. These habits are worthy of more critical attention from students of animal behavior.—KARL P. SCHMIDT, *Field Museum of Natural History, Chicago.*

A CHIPMUNK KILLS A SPARROW

Doctor Loye Miller's account of a predatory squirrel, in the issue of the Journal of Mammalogy, for November, 1935, p. 324, leads me to offer a description of a somewhat similar experience with a chipmunk (*Tamias striatus fisheri*).

On a summer's day in 1935 I stood watching a number of house sparrows indulging in

a communal dust bath in the New York Zoological Park. The site was an outcropping of a rock ledge, roughly 3 feet in diameter. The dry earth in the crevices had become reduced to dust by continued dry weather, forming pockets nicely suited to the sparrows' purpose. At one side of the bare space stood a thick growth of tall weeds. As I watched, a large chipmunk dashed from this cover into the crowd of prostrate sparrows. He covered a distance of about two feet in a flash, seized and bit a sparrow, dropped it and tore back into the weeds, all in what seemed a split second. At the squeal of the victim, the chattering sparrows instantly became silent, then flew to a small overhanging bush, where they sat motionless, apparently hardly realizing what had happened. The stricken sparrow, evidently mortally hurt, jerked convulsively, and then rolled slowly down the face of the rock and fell into a dense mass of weeds at the bottom, probably 5 or 6 feet from the spot where it had been dusting. I remained immobile, not more than 10 feet away. After an interval of perhaps a minute, I saw the chipmunk coming down the side of the rock, still under the weeds. In order to retain their protection, it was necessary for the chipmunk to take a circuitous route; nevertheless, it went as directly as possible to the clump that concealed the sparrow, found it almost at once and soon returned along the base of the rock, carrying the bird in its mouth. Proceeding along this lower level for 15 or 20 feet, the chipmunk entered a hole under the rock, at the base of a small tree, dragging the lifeless sparrow after him. Although the whole episode gave the impression of much experience on the part of the chipmunk, I watched in vain, on several occasions, for a repetition.—Lee S. Crandall, *New York Zoological Park, New York City.*

NOTES ON NEW HAMPSHIRE CHIPMUNKS

The following notes on chipmunks (*Tamias striatus lysteri*) have been taken from observations made two miles south of Center Ossipee, New Hampshire, during 1932, 1933, and the summer and fall of 1934. Accounts of this species in the literature appear to vary somewhat in respect to general habits associated with food-getting, breeding, and dates of hibernation, if this occurs. The accumulation of data on the 5 races of chipmunks may lead to the possibility of a comparative life-history study, and with this in mind, these notes are offered.

Food.—The cheek-pouch and stomach contents of several specimens have been identified. These analyses, supplemented by field observations and the examination of a food cache, indicate that the animals in this vicinity feed largely on nuts. Their diet, however, is not greatly restricted, as is evidenced by identifications made by J. R. Malloch of the Bureau of Biological Survey. The pouch and stomach contents of specimens collected in October, 1934, contained the skin and pulp of drupelets (*Prunus* sp.); the gelatinous remains of some unidentifiable mushroom; fragments of a carabid beetle; and the larvae of *Bibio* (March fly) which were so tightly packed in the pouches that they extruded from the mouth when the specimen was obtained.

During the latter part of June, I opened a food cache, on the ground at the bottom of a stone wall. It contained the following: 3,000 cherry stones (*Prunus serotina*); one elytron of a beetle; the remains of a snail; 10 plum seeds; pieces of dried apple; several pine cone scales; and a portion of one beechnut. Three-quarters of the cherry stones had been split into halves, while the remainder had been gnawed through the center or at the edge of the exocarp.

Acorns are eaten by holding the nut in the forepaws and rotating it, thus removing strips about three-eighths of an inch in width. Three acorns have been taken from the pouches of a single individual.

The drupes of *Prunus serotina* ripen about the last week in August and these trees probably furnish the most important winter food. Indian corn is a favorite food for

such individuals as have their burrows located in favorable situations. The husks are cut off at the base and stripped vertically, thus providing a platform on which to stand and reach the higher kernels. Chipmunks have not become a serious pest in this locality.

Strawberries, raspberries, beechnuts, and rock maple samaras also are eaten.

Tree-climbing.—Several specimens have been discovered in trees, generally feeding. One was eating maple samaras, and two others were gathering cherries. I accidentally intercepted chipmunks on two different occasions as they were about to enter their burrows. In both instances they sought refuge in trees. Those noted have climbed about very cautiously, especially in one instance when the animal shifted to a neighboring branch in order to escape. When thoroughly frightened they can descend a tree trunk very rapidly. On August 24, 1934, a chipmunk was seen feeding on the samaras of a rock maple during a drizzling rain. The animal was at the end of a branch approximately 20 feet above the ground. I climbed after him, wondering how he would make his escape. He paid me no attention until I shook the branch, when he ran beneath the branch which supported me.

Parasites.—The stomach or intestines invariably are filled with parasitic roundworms, which generally occupy the entire stomach cavity. It may be that after the death of the animal they migrate from the small intestine to this situation. They are absent from the large intestine.

Cuterebrine parasitism is not as common here as Merriam (Insect Life, vol. 1, p. 215) recorded for the south end of Lake Champlain, New York, in October, 1885. Merriam estimated that 50 per cent of the chipmunks killed had been parasitized. Warbles have been noted on 3 specimens, in one instance on the forelimb, slightly ventral to the axial region. Others have been found overlying the penis. One warble measured 19 by 14 mm. A chipmunk was shot on October 3, 1934, with the larvae absent and the cyst filled with pus. Parasitism of this type apparently has little effect on the vitality of the animal.

Hibernation and emergence dates.—Two chipmunks were seen on December 1, 1934, but the weather that fall had been unseasonably mild. Dates of hibernation apparently depend on weather conditions. A. E. Preble told me of having seen chipmunks on March 17, 1935. Probably this is about the average date for emergence in this section.

Blindness and tail mutilation.—Of 80 chipmunks collected in this vicinity, only one was blind. In this instance the right eye was affected. A part of the tail of this animal, and of one or two others, had been lost. It has been suggested that this is caused by loss of the skin of this member, but it is possible that chipmunks may employ the same tactics as the gray squirrel, and that they bite at the hindquarters of a fleeing enemy, the tail, in this case, often receiving the brunt of the attack.

Activity.—Chipmunks seldom were seen between the hours of 11 A.M. and 2 P.M. during June and July. Whether they always take a noon siesta awaits further observation. At any rate they have been conspicuously absent between these hours. This does not hold true during the latter part of August, for then they begin storing food for winter use and are active at all hours.—Norman A. Preble, *Museum of Birds and Mammals, Lawrence, Kansas.*

NOTES ON THE HIBERNATION OF A WESTERN CHIPMUNK

A pair of adult western chipmunks (*Eutamias amoenus canicaudus*), were secured during the spring of 1933 at Kamiak Butte, a forested, quartzite outcrop some 15 miles northeast of Pullman, Washington. During the spring and summer months they were kept and observed in a greenhouse which served as an animal room. During the fall of the year they were transferred to an experimental plot, erected through the coöperation

of the Bureau of Biological Survey, where an investigation concerning the life history of the Yakima ground squirrel is in progress. Placed in two unoccupied nest boxes and runways, they made themselves at home immediately and constructed a nest of cotton batting in boxes provided for the purpose. They began also to bring into the nest box as much grain as they could gather, and stored it in the corners. This was during September and October, when ground-squirrels in the neighboring pens and boxes had been in hibernation for several months.

As cold weather approached, the chipmunks became less and less active and were loath to leave their warm nest boxes when disturbed. At no time did they become as fat as the hibernating ground-squirrels. During the latter part of November the male had gone into hibernation, although the female in the adjoining pen still was active. On December 1, however, she was found also in the torpid state. On December 2 the male was awake and feeding upon some of the stored food material, but on the third he had gone back once more into hibernation. This he continued to do throughout the months of December and January, alternately awakening for a short time and then going back into a torpor. After the end of January, however, he was active every time the nest was examined.

In hibernation the chipmunks assumed the typical position, curled into a ball with the nose placed between the hind legs, and the long furry tail curled over the body. They feel cold to the touch and the respiration rate is very slow. Compared to hibernating ground-squirrels, chipmunks are not necessarily "deep" hibernators, for when handled they awaken much sooner than ground-squirrels under the same conditions. Since these animals are alternately awake and in hibernation during the winter months, it is readily understood why chipmunks have been seen outdoors on warm, sunshiny days even in the middle of winter.—Arthur Svihla, *State College of Washington, Pullman Washington.*

A FIGHT BETWEEN A BEAVER AND A BULL MOOSE

During October, 1935, Mr. Thorbjörn Ommundsen, an inspector of the forests belonging to Nes Jernverk, encountered a drama of wild life that had been enacted in a thicket of trees in a marsh in Hummelsgård, Vegårshei, the neighboring county to Aamli. In a glade the ground was torn up and deeply scored by the tracks of a moose, with evidence of a struggle having taken place. Here he found a lifeless beaver that had met its end by having been gored, and it was evident that a moose had been the rodent's adversary, to which fact patches of blood and fur also bore mute witness. The reason why such a powerful beast should vent his rage on an animal of such relative puniness as the other, must remain a mystery.—Sigvald Salvesen, *Aamli, Norway.*

STATUS OF MICROTUS ENIXUS AND MICROTUS TERRAENOVAE

An examination of specimens of the *Microtus pennsylvanicus* group of meadow-mice indicates that the forms *M. enixus*, *M. terraenovae* and *M. p. fontigenus* are conspecific. Bailey (North Amer. Fauna, no. 17, 1900) treated *enixus* and *terraenovae* as distinct species. *M. p. enixus* is found on the Labrador coast from Hamilton Inlet to Ungava Bay, and *M. p. terraenovae* in Newfoundland and on Penguin Isle. *M. p. fontigenus* is the race of *M. pennsylvanicus* which inhabits the Hudsonian Zone of eastern Canada. Since the ranges are contiguous and the habitat similar, it was suspected that the forms are merely races of a single species.

The differences found between the forms *pennsylvanicus*, *enixus*, and *terraenovae* are only of subspecific value. The dentition (examined by means of camera lucida drawings) shows no differences, and the pelage and size differ only in degree. It is necessary, then, to treat the forms *enixus* and *terraenovae* as subspecies of *Microtus pennsylvanicus*.

The differences occurring are outlined below. Full descriptions have been given by Bailey.

Microtus pennsylvanicus enixus Bangs.—Smaller than *M. pennsylvanicus*; tail long; upperparts darker; underparts without rufous tinge; tail less distinctly bicolor, often unicolor. Auditory bullae angular; skull and dentition otherwise as in *pennsylvanicus*. Measurements (10 topotypes): Total length, 152.1; tail, 46.8; hind foot, 21.6 mm. Specimens examined: Labrador, Hamilton Inlet, 47; Black Bay, 61. The ratio of total length to tail length is 30.9 per cent. This ratio in *pennsylvanicus* is 27.5; in *fontigenus*, 26.4; in *terraenovae*, 28.0 per cent.

Microtus pennsylvanicus terraenovae (Bangs).—Size as in *pennsylvanicus*. Upperparts and sides decidedly lighter, more uniform; underparts without any rufous tinge; definite buffy nose patch present. Skull and dentition similar. Measurements (11 topotypes): 173; 48.5; 22.8 mm. Specimens examined: Codroy, Newfoundland, 58.

In 44 per cent of 50 skulls examined, M_1 had a small posterior loop. This loop occurs occasionally in typical *pennsylvanicus*.

Microtus pennsylvanicus fontigenus Bangs.—Smaller than typical *pennsylvanicus*. Upperparts less rufous; underparts without rufous tinge; gray of underparts extending upward around the nose patch and forming a semi-crescent. Auditory bullae decidedly rounded; skull and dentition otherwise as in *pennsylvanicus*. Measurements (5 topotypes): 148; 39.0; 20.5 mm. Specimens examined: Lake Edward, Quebec, 5.

This race may prove on examination of a larger series of specimens to be inseparable from typical *pennsylvanicus*.—DAVID E. DAVIS, *Cambridge, Massachusetts.*

MICROTUS OCHROGASTER IN MINNESOTA

The presence of *Microtus ochrogaster* in Vernon County, Wisconsin, led me to look for it in the next Minnesota county adjacent on the west. While setting a trap line near Caledonia, Houston County, Minnesota, March 21, 1935, I found a dead adult female of this species. It was in fairly fresh condition and was made into a skin for my personal collection. Five other specimens were taken subsequently. One of these, also an adult female, was skinned May 4, 1935, and the remainder were given to other collectors.

Forty pellets of the barred owl (*Strix varia*), collected in the vicinity of Caledonia in the spring of 1935, contained 6 of these mice, while 30 pellets of the horned owl (*Bubo virginianus*) contained one. A. L. Nelson, Bureau of Biological Survey, kindly made the analyses.

In this vicinity *Microtus ochrogaster* inhabits the south slopes of hillsides where the grass has not been heavily grazed. It may occur also on the savannah-like areas at the tops of ridges; but it has not yet been taken where there are trees. The mouse is to be found occasionally frequenting hay stacks in hay meadows of grassy bottomlands, together with *Microtus pennsylvanicus*.—PHILIP F. ALLAN, *Soil Conservation Service, Bath, Maine.*

PINE MICE IN VERMONT

Seven pine mice, *Pitymys pinetorum scalopsoides*, comprising two adults, two subadults and three immature specimens, were collected in Vermont during 1935. The first was taken at Sherburne, elevation 2,000 feet, in the Canadian Zone, about 4 miles from the nearest edge of the Transition Zone. The trap was set in a *Clethrionomys* runway. This record seems unusual in that the *Pitymys* was associated with a typical Canadian fauna. The other 6 were taken at Saxtons River, elevation 500 feet, near the edge of an oat field and in tunnels not over 10 feet from the highway. This colony was associated with *Parascalops breweri*, *Microtus p. pennsylvanicus* and *Blarina b. talpoides*. George G. Goodwin of The American Museum kindly compared two of the series and found that

the only adult submitted was slightly lighter in color than typical specimens from Connecticut.

The diversity of habitat and distance between these colonies (about 60 miles) seems to indicate a general spread northward of this species, and other New England records are to be expected. So far as I know, this is the first record of the species for Vermont.—F. L. Osgood, *Rutland, Vermont.*

THE HOUSE MOUSE IN GRAND CANYON NATIONAL PARK

The first record for the house mouse (*Mus musculus musculus* Linnaeus) in Grand Canyon National Park was secured July 25, 1935, by Naturalist E. D. McKee. The specimen was trapped in a residence of the village on the south rim of the canyon. Previously the mice trapped regularly in the residences had been Arizona wood mice (*Peromyscus maniculatus rufinus*) and not house mice. Since July 25, house mice have been trapped in the granary of the general store on the south rim. It seems likely that house mice may have arrived at Grand Canyon either in loads of produce from Williams or Flagstaff, or aboard C.C.C. trucks driven to a camp near the village.

It remains to be seen if this species will take to the fields here as it has in other localities.—John R. Arnold, *281 Madison Street, Coalinga, California.*

A NEW GENUS AND A NEW SUBSPECIES OF AFRICAN DORMOUSE

When, in 1925, Thomas and Hinton subdivided the old genus *Graphiurus*, previously used to include all the African dormice south of the Sahara, they restricted that name to the large Cape dormouse, *Graphiurus ocularis* (A. Smith), of the Cape of Good Hope. At the same time they proposed a new generic name, *Gliriscus*, type species *G. platyops* Thomas, for the rock dormice, leaving all the remaining species of forest dormice in a third group, for which the generic name *Claviglis* of Jentink (type species *C. crassicaudatus* Jentink) was revived. This last group thus is fairly homogeneous except for the inclusion of a much larger animal found in the forest country of extreme western Africa (Senegal to the Cameroons), namely, *Graphiurus hueti* of de Rochebrune. This is of nearly twice the size of the small species of *Claviglis*. Its type locality is near St. Louis, coast of Senegal. A related form was described by Jentink in 1888 from Liberia and the Gold Coast under the name *Graphiurus nagtglasii* (Notes Leyden Mus., vol. 10, p. 38, 1888). Jentink pointed out that de Rochebrune's figure in his plate 6, fig. 2, does not agree altogether with the description he gave of *Graphiurus hueti*, and no doubt it is none too accurate. On geographic grounds it is highly probable, nevertheless, that the latter is at least racially distinct from the Liberian dormouse. This, in turn, agrees well, so far as the description goes, with a similar animal occurring in the Cameroons, of which the Museum of Comparative Zoology has two specimens.

A comparison of these last with *Claviglis* of several forms, including the genotype, reveals important characters which may be used to set apart in a special genus the large dormouse, to be called **Aethoglis**, genus novum, with genotype *Graphiurus nagtglasii* Jentink. The chief distinguishing characters, as determined by a study of the Cameroon specimens, are as follows: Size large, about as in *Glis glis* (hind foot 30 mm.); tail distichous, not tapering; no black facial stripe nor eye-ring. Skull and teeth in general much as in *Claviglis*, except for much larger size. The chief characters for diagnosis are as follows: 1) Bullae in side view less inflated, and with the anterior division marked off externally by a slight anteroventral notch instead of being evenly rounded; 2) zygomata less bowed, so that the greatest zygomatic width is across the bases of the squamosal processes instead of anterior thereto; 3) nasals modified, differing strikingly in that they are of nearly uniform narrowness throughout, with a straight inferior border, instead of being spatulate as in *Claviglis*, and with the lower border turned down

anteriorly; 4) vomer continued backward to the posterior edge of the bony palate, to form a complete dividing wall between opposite halves of the posterior nares; 5) the upper incisors have their convex enamel-covered front facing anteriorly as normally, whereas in *Claviglis* this surface is turned strongly inward at an angle of nearly 45 degrees toward the midline; 6) the upper premolar (PM^4) is situated farther forward, opposite the anterior root of the zygoma instead of just back of it.

The described forms of the genus and their type localities thus are *Aethoglis hueti hueti* (Rochebrune), St. Louis, Senegal; and *Aethoglis hueti nagtglasii* (Jentink), Du Queah (or Du) and Farmington rivers, Liberia.

Typical *hueti* was described as ochraceous fulvous above, with reddish feet, and is shown so in de Rochebrune's plate. The Cameroons animal is much darker, gray with a faint tinge of russet above, while the belly is clear gray with the hairs tipped with whitish.

Through the courtesy of Gerrit S. Miller, Jr., U. S. National Museum, I have been able to compare a specimen from Liberia (Mt. Coffee), practically a topotype of *nagtglasii*, with others from the Cameroons. From this study it appears that the latter easily are distinguishable by their much more silvery instead of russet upperparts, particularly noticeable on the head; the belly too, is less dark with more silvery tips to the slate-colored hairs. The Cameroons animal may be known as follows:

Aethoglis hueti argenteus, subsp. nov.

Type:—Adult female, skin and skull, no. 17920 Mus. Comparative Zoology; from Lolodorf, Cameroons, Africa; collected March 17, 1911, by George Schwab.

Description.—General color of the upperparts drab gray, the individual hairs in the median area from occiput to base of tail drab, much mixed with hairs having pale whitish and shiny tips. On the sides the drab element passes into buff. The fur of the under side of the body and limbs generally is darker gray at base with prominent whitish tips; that about the mouth and on the under side of the forearms nearly clear shining white; central area of hands and feet clear drab, their edges and the digits whitish. The ears are practically naked; tail distichous, its long hairs drab brown, slightly paler (drab) below, and with a slight admixture of white hairs. The vibrissae are black.

In the type, the upper chest is stained with ochraceous, as often it is in dormice, probably from some special food (pollen?), while the tip of the tail is broken, as frequently is the case in this group. Compared with typical *nagtglasii*, the Cameroons race is much less warmly colored, particularly with grayer cheeks, forehead, and occiput, while the back also is paler drab and the belly with whitish-tipped instead of gray hairs. The skulls are not essentially different.

Measurements.—The type from Lolodorf, measured in the flesh as follows: Head and body, 145; tail, 84; hind foot, 32; ear, 20 mm. A second specimen from Metet, Cameroons, measured: Head and body, 134; tail, 149 mm. A third individual from Efulen, Cameroons (U. S. Nat. Mus.) had a total length of 290; hind foot, 30; ear, 21 mm.

Skull.—The skull of the type and of no. 125434, U. S. Nat. Mus. (from Efulen), measure respectively: Greatest length, 38.4, 38.9; basal length, 33.2, 33.7; palatal length, 17.0, 17.0; zygomatic width, 22.4, 22.3; mastoid width, 16.9, 18.8; width across molars, 8.4; upper cheek teeth (crowns), 5.9, (alveoli) 5.8; lower cheek teeth (crowns), 5.4, 6.7 mm.—Glover M. Allen, *Museum of Comparative Zoology, Cambridge, Massachusetts.*

THE NINE-BANDED ARMADILLO IN NORTHEASTERN OKLAHOMA

The nine-banded armadillo (*Dasypus novemcinctus texanus*) may have occurred in Oklahoma for some time, for I recall having seen, several years ago, a newspaper account of the capture of an individual in southern Oklahoma. I know of only two records,

however, for the northeastern part of the state. One of these animals was captured in December, 1932, by raccoon hunters in Rogers County, about 20 miles east of Tulsa, in the valley of the Verdigris River. A second individual was caught in August, 1935, by a farmer in the valley of the Arkansas River, Creek County.

The published range of this species does not extend north of Latitude 33 degrees. If the two individuals mentioned above reached the region through their own efforts, the fact probably is indicative of a northward spread of the armadillo by way of the valleys of the Red and Arkansas rivers. There is, of course, the possibility that these individuals were transported by man. Their occurrence, however, in different years and in different localities, but in valleys of the same river system, points rather strongly to the probability that they reached northern Oklahoma independently of human agency.

There is considerable evidence that the armadillo is increasing its range rather rapidly. Strecker (Jour. Mamm., vol. 7, pp. 206–210, 1926) has presented data indicating that this mammal is spreading eastward in Texas. He did not record it, however, from any locality north of Latitude 33 degrees, the northern limit of the armadillo's range as defined by Bailey (North Amer. Fauna, no. 25, p. 54, 1905).

If the two individuals from northeastern Oklahoma actually indicate a northward movement of the species, then the belief of Newman (Amer. Nat., vol. 47, p. 518, 1913), that spread of the armadillo north of Latitude 33 degrees is blocked by temperature barriers, is unfounded.—W. Frank Blair, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

EIGHTEENTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF MAMMALOGISTS

The eighteenth annual meeting of the American Society of Mammalogists was held at the Academy of Natural Sciences, Philadelphia, Pennsylvania, from May 12 to 16, 1936. There were 76 members present, representing eleven states, the District of Columbia, and one Canadian province.

PROGRAM

Tuesday, May 12

8:00 *p.m.*

Meeting of the Board of Directors at Robert Morris Hotel

Wednesday, May 13

10:00 *a.m.*

1. Address of Welcome. Charles M. B. Cadwalader.
2. Winter pelages of some North American shrews. Morris M. Green.
3. Fertility relations in the *Peromyscus leucopus* group of mice. L. R. Dice.
4. Vermont bobcats. W. J. Hamilton, Jr.
5. Studies of the larger predatory mammals by Michigan's Conservation Department. A. M. Stebler.
6. Spring and summer food of gray foxes in Virginia. Arnold L. Nelson and C. O. Handley.
7. The reproductive cycle of the coyote. G. W. D. Hamlett.

2:00 *p.m.*

Annual Business Meeting of the Society

3:50 *p.m.*

8. General Wildlife Federation. H. E. Anthony.
9. Recent activities of the American Committee for International Wild Life Protection. Harold J. Coolidge, Jr.
10. Biological National Monuments and Wildlife Conservation. Victor H. Cahalane.
11. Status of some vanishing species in California. Joseph Dixon (Read by H. C. Bryant).

8:00 *p.m.*

The members of the Society were entertained at a smoker held in the Department of Vertebrates at the Academy.

THURSDAY, MAY 14

9:00 *a.m.*

12. Osteological comparisons between two fossorial rodents: *Cryptomys* and *Thomomys*. John Eric Hill.
13. Presentation of a monograph on the White River mammalian fauna. Part I. W. B. Scott.
14. Mammal distribution in the Philippines and its bearing on Paleogeography. Edward H. Taylor.
15. Relationships of the Okapi. Edwin H. Colbert.
16. The tail membrane in phyllostome bats. Glover M. Allen.
17. A comparative study of the tail vertebrae in several groups of mammals. W. Frank Blair (Read by W. H. Burt).
18. Isle Royale moose study. Paul F. Hickie (Read by H. D. Ruhl).

2:00 *p.m.*

19. A procedure of observation and description of coat and skin characters in captive chimpanzees. Harold J. Coolidge, Jr.
20. Waltzing and epilepsy in deer mice. L. R. Dice.
21. The larger mammals of the Okefinokee Swamp Region. Francis Harper.
22. The significance of fences and old stone walls in relation to the fauna and flora of farms and state park areas, with special reference to mammals. H. P. K. Agersborg.
23. Traps for taking animals alive and uninjured. Vernon Bailey.
24. Bat banding. Donald R. Griffin.
25. The keeping of bats in captivity. William H. Gates.

7:00 *p.m.*

The Annual Dinner of the Society was held at Holland's, after which members returned to the lecture hall, where George G. Goodwin of the American Museum of Natural History, New York, showed a film entitled "Eight Thousand miles of Northern Wilderness" with pictures of wood bison, musk oxen, caribou, white and Stone's sheep, taken on the Henry Snyder 1935 Barren Land Expedition.

FRIDAY, MAY 15

9:00 *a.m.*

26. Extrusive growth and attrition of incisors in *Cavia*. Albert R. Shadle, Nicholas Valvo, and Kenneth Eckhert.
27. Report on some small mammals from the Cape Charles Peninsula. David G. Nichols.

28. The ecological distribution of the mammals of the sand hills of Nebraska. Burton T. Ostenson.
29. Notes on the distribution of the red squirrels (*Tamiasciurus*). A. H. Howell.
30. The monsoon in the Chinese Himalaya. Brooke Dolan II.
31. Studies on populations and movements of small mammals. William Henry Burt.
32. The Giant Panda: Bear or Panda? William K. Gregory.

2:00 *p.m.*

33. The Nubian ibex and the wild saladang. Harold J. Coolidge, Jr.
34. Food habits of the prairie dog. Leon H. Kelso.
35. Primate skull base: Man in several types. Thomas Horace Evans.
36. Mammals of the Olympic wilderness. Adolph Murie (Read by V. H. Cahalane).

3:30 *p.m.*

Final Business Meeting of the Society

SATURDAY, MAY 16

9:30 *a.m.*

Members enjoyed a personally escorted tour through the Zoological Garden.

At the meeting of the Directors on May 12, a possible fifteen-year index to the Journal was discussed, and President Anthony was instructed to appoint a committee to consider the task of preparing such an index. W. Reid Blair was re-elected as trustee for 1936–1939.

At the annual business meeting all of the officers proper of the previous year were re-elected. The Directors for 1934–1936 were re-elected for the 1936–1938 term. A. H. Howell was elected Director for 1935–1937 to fill the vacancy caused by the appointment of A. B. Howell as Chairman, Editorial Board.

Members of the Society will be pleased to learn that A. W. Anthony and William Berryman Scott unanimously were elected to the class of honorary membership in token of their services to mammalogy.

During the past year the Society has learned with deep regret of the deaths of the following twelve members, six of whom were charter (*) members of the Society: William Louis Abbott,* Edward M. Ball,* Charles A. Gianini,* C. V. Green, Karl B. Hanson, Henry Fairfield Osborn,* F. J. W. Schmidt, Harry S. Swarth,* Hartley Thompson, Roger W. Toll, Harry E. Wilder,* George M. Wright.

A summary of the report of the corresponding secretary follows:

New members elected at current meeting	84
New subscriptions received since last meeting	34
Total gross addition to the mailing list of the Journal	115
Resignations since last meeting	21
Deaths reported	12
Number delinquent in dues two years	30
Number delinquent in dues one year	77
Number of honorary members	2
Number of life members	58
Number of annual members	741
Total number of members	801
Number of subscribers	149
Total present mailing list	839

The membership in the Society steadily has increased during the past year, due largely to the loyal members who have proposed for membership colleagues and students interested in mammalogy. It is hoped that members will continue to aid the Society in this way. Members will also confer a great favor upon the treasurer and corresponding secretary if they will pay their dues promptly at the beginning of the year. The cancellation and reissuing of Journal subscriptions is a most onerous task which could be eliminated from the arduous duties of these officers if members would coöperate.

The financial standing of the Society is the best it has been for some time, and a larger, better Journal is planned by the editor.

At the final business meeting of the Society, invitations from Washington, D. C. to hold the 1937 Annual Meeting in that city were accepted.

Reports by the following committees were read and accepted: Editorial, Life Histories and Ecology, Marine Mammals, Economic Mammalogy, and Conservation of Land Mammals.

The Society passed resolutions expressing its appreciation to the President and Board of Trustees of the Academy of Natural Sciences and to Mr. Charles M. B. Cadwalader, Managing Director of the Academy, for facilities and courtesies extended: Also to the President and Board of Directors of the Zoological Society of Philadelphia for their courteous invitation to visit the Zoological Garden, and to the Local Committee on arrangements for their untiring efforts toward the success of the meeting and the enjoyment of the members.

In addition, the Society adopted the following resolutions:

WHEREAS, the United States Government through the Department of the Interior, authorizes the establishment of a national park in the southern section of the Everglades region of Florida; and

WHEREAS, the Department of the Interior officially stated that this region combines, from a national park standpoint, features of outstanding importance; and

WHEREAS, the United States Government has by Act of Congress (May 30, 1934) authorized the establishment of the Everglades National Park; and

WHEREAS, such a park will be of utmost importance in the conservation of wild life and will create a haven for native wild life; and

WHEREAS, its inspirational value from a national park standpoint is officially claimed to be of the highest standard; and

WHEREAS, the Department of the Interior recommends that the name of the park will be the "Everglades National Park";

Now, therefore, Be It Resolved by the American Society of Mammalogists:

Section 1. That this Society goes on record as favoring the Everglades National Park.

Section 2. That a copy of this resolution be forwarded to: The President of the United States, The Governor of the State of Florida, The Secretary of the Interior, The National Park Service, U. S. Department of the Interior, The National Parks Association, The Everglades National Park Association, and The Associated Press, Jacksonville, Florida.

WHEREAS, it has come to our attention that under the Emergency Conservation Works program unusual pressure has developed to conduct poison campaigns in an endeavor to secure rodent control on large areas, particularly as a part of the reforestation and erosion control programs; and

WHEREAS, the use of poison is not selective and may kill many valuable birds and mammals as well as ground squirrels, rats, and mice,

Now, therefore, Be It Resolved by the American Society of Mammalogists:

Section 1. That no such control campaign be started until after a thorough field in-

vestigation of *the specific area* has been made and reported on by a qualified trained wildlife representative of the Biological Survey or the National Park Service.

Section 2. That in such investigations full consideration shall be given to the ecology of *all* animal and plant species on the particular area under consideration.

Section 3. That all control campaigns must be specific and local, not general or wide-spread.

Section 4. That where control of rodents is found to be essential on a given area, every possible effort shall be made to secure the needed control through selective methods such as trapping, shooting or by treatment of *used* burrows with carbon-bisulphide rather than by the broadcast of poisoned grain.

Section 5. That a qualified trained foreman shall in all cases supervise and be held responsible for all work of this nature which must never be delegated to unsupervised men.

Section 6. That a copy of these resolutions be prepared and sent to each Regional Officer and to the Director of the Forest Service, National Park Service and Soil Conservation Service of the Federal Government.

REVIEW

Guyer, Michael F. ANIMAL MICROLOGY. Practical exercises in zoological microtechnique. 4th ed. 1936. Pp. i–xvi, 1–331, University of Chicago Press, Chicago. Cloth, $2.50.

The fourth edition of this book continues the traditional procedure of the earlier editions. It remains a book for the initiate into microscopical technique, and tells him in a very practical way "what to do with his material, step by step." The new edition has the same serious handicap as the previous editions, in that there is no, or a minimal, exposition of the theory of fixation and of staining. There also is no trace of a historial concept of the development of methods and its scientific meaning. To the extent that these things are weak or absent, the book does nothing to mitigate the feeling among students that histology and its methods proceed by chance and black magic. The sections on supra- and intravital technique and on microchemistry still are in need of a thorough revision.

The book includes an extensive discussion of the new dioxan method. An attempt is made to bring it further up to date with references in various chapters to recent developments in microscopical technique, and with outlines of some newer methods.

The book in its present form will be of assistance to technicians and beginning students. For mammalogists not acquainted with microscopic methods this book will give easily available advice on the preservation in the field of material later to be used for histological purposes.—I. GERSH.

LIST OF RECENT LITERATURE

[Conducted by Arthur H. Howell, Remington Kellogg, and Gerrit S. Miller, Jr.]

ADLOFF, PAUL. Über die Cope-Osborn'sche Trituberkulärtheorie und über eine neue Theorie der Differenzierung des Säugetiergebisses von M. Friant-Paris. Anat. Anz., vol. 80, nos. 5–8, pp. 96–119, figs. 11. May 16, 1935. (Destructive criticism of Friant's hypothesis.)

AICHEL, OTTO. Die Bulla nasolacrimalis des Gorilla. Zeitschr. Morphol. u. Anthrop., Stuttgart, vol. 34 (Festbd. Eugen Fischer), pp. 21–40, figs. 4, pls. 5. April, 1935.

ALEKSANDROVA, V. D. Summer food of the reindeer on Gussinaya Zemlya (Novaya Zemlya). Trudy Arkticheskogo Instituta (Trans. Arctic Inst., Leningrad), vol. 22, pp. 35–50. 1935. (In Russian with English summary.)

ALEXANDER, HUBERT G., and PAUL REITER. Report on the excavation of Jemez Cave, New Mexico. Monograph Univ. New Mexico School Amer. Research, Santa Fe, pp. 67 + iii, figs. 17, pls. 20. 1935. (List of mammals, pp. 35–36.)

ALLEN, GLOVER M., and BARBARA LAWRENCE. Scientific results of an expedition to rain forest regions in eastern Africa. III. Mammals. (With field notes by Arthur Loveridge.) Bull. Mus. Comp. Zool. at Harvard College, vol. 79, no. 3, pp. 31–125, pls. 5. January, 1936. (New: *Nycteris nana tristis*, *Saccostomus cricetulus*.)

ANDERSON, OTTO L. The "Flapper." Minnesota Conservationist, no. 24, pp. 8–9, 24–32, illus, May, 1935. (Popular account of beaver habits.)

ANGHI, CS. G. On a prepared specimen resembling Equus zebra frederici Trouess. from the collection of the Stuttgart "Naturaliensammlung." Ann. Mus. Nat. Hungarici, Budapest, vol. 29, Pars Zool., pp. 166–168, fig. 1. June 3, 1935.

ANONYMOUS. "Bring 'em back alive"—As moving pictures and for exhibition in zoölogical gardens. Illus. London News, vol. 181, no. 4866, pp. 116–117, illus. July 23, 1932.

——— The king of the apes in his native jungle: Scenes from "Congorilla"—A wonderful sound-film of forest life in Africa. Illus. London News, vol. 181, no. 4866, pp. 132 133, illus. July 23, 1932. (Excellent photographs of gorillas.)

——— The new pair of gorillas now the "Zoos" most popular attraction. Illus. London News, vol. 181, no. 4872, p. 335, illus. September 3, 1932. (Two gorillas from French Congo, male aged 7 years and female 8 years.)

——— The first bongo—Rarest of East African antelopes—Kept in captivity abroad: A young female successfully taken to New York by way of London. Illus. London News, vol. 183, no. 4931, pp. 642–643, illus. October 21, 1933. (*Boocercus eurycerus isaaci*.)

——— The wild animals of the Indian Empire and the problem of their preservation. Pt. 1. Journ. Bombay Nat. Hist. Soc., vol. 36, no. 4, suppl., pp. 1–39, pls. 1–14, col. pl. 1. December 15, 1933. Pt. 2, *Ibid.*, vol. 37, no. 1, suppl., pp. 59–96, pls. 15–36, col. pls. 2–12. April 15, 1934. Pt. 3. *Ibid.*, vol. 37, no. 4, suppl., pp. 112–161, pls. 37–52, col. pls. 13–15. April 15, 1935. [S. H. Prater, editor.]

——— Musk rats in Scotland. Scottish Journ. Agric., Edinburgh, vol. 18, no. 2, pp. 175–178. April, 1935.

——— Wild animals of the Hudson Highlands. Natural History, New York, vol. 35, no. 5, pp. 405–410, illus. May, 1935.

ANTEVS, ERNST. The spread of aboriginal man to North America. Geogr. Rev., vol. 25, no. 2, pp. 302–309. April, 1935. (As far as known the land route from central Asia to central North America was opened 20,000 to 15,000 years ago.)

ANTHONY, R., and A. HERPIN. Soudure précoce de la deuxième incisive (prétendue dent de lait) et de la troisième incisive (défense) chez l'élephant d'Asie (Elephas

indicus L.). Archiv. Mus. Nat. d'Hist. Nat., Paris, ser. 6, vol. 12, pp. 219–223, figs. 2. June, 1935. (Volume du Tricentenaire, vol. 1.)

ANTONIUS, OTTO. Beobachtungen an Rindern in Schönbrunn. II. Banteng, Gaur, Gayal. Zool. Garten, Leipzig, n.F., vol. 5, nos. 7–9, pp. 178–191, figs. 7. October, 1932.

——— Beobachtungen an Einhufern in Schönbrunn. VII. Halbesel. Zool. Garten, Leipzig, n.F., vol. 5, nos. 10–12, pp. 261–275, figs. 9. December, 1932.

APPELMAN, E. J., and P. F. FRANCK. Rhinoceros sondaicus in West-Java. De Tropische Natuur, Buitenzorg, Jahrg. 23, no. 4, pp. 73–79, figs. 2. April 19, 1934. (Photographs of freshly killed animal and measurements of the skeleton.)

ARAMBOURG, C. and R. JEANNEL. La mission scientifique de l'Omo. Comptes Rendus Acad. Sci. Paris, vol. 196, no. 25, pp. 1902–1904. June 19, 1933. (Southern Ethiopia; fluvio-lacustrine deposits containing profusion of mammals, including *Dinotherium*.)

ASHLEY-MONTAGU, MONTAGUE FRANCIS. The location of the nasion in the living. Amer. Journ. Phys. Anthrop., vol. 20, no. 1 and suppl., pp. 81–93, fig. 1. April-June, 1935.

——— Restoration of an Egyptian mummified foot. Amer. Journ. Phys. Anthrop., vol. 20, no. 1 and suppl., pp. 95–101, pls. 2. April-June, 1935.

——— The premaxilla in the primates (concluded). Quart. Review Biol., vol. 10, no. 2, pp. 181–208, figs. 11. June, 1935.

ASTRE, GASTON. Mammifères des lignites pontiens d'Orignac. Bull. Soc. Hist. nat. Toulouse, vol. 64, pp. 581–584. December 30, 1932.

AULMANN, G. Das neue Affenhaus im Düsseldorfer Zoo. Zool. Garten, Leipzig, n.F., vol. 6, nos. 1–3, pp. 48–56, figs. 7. May, 1933.

BAHR, EDGAR. Silberfuchsplauderei. Der Deutsche Pelztierzüchter, Munich, Jahrg. 9, no. 2, pp. 29–32, illus. January 15, 1934.

BAILLIE, JAMES L., JR. Some notes on the cottontail in Ontario. Canadian Field-Nat., vol. 49, no. 4, pp. 70–71. April, 1935.

BARABASH, I. I. Delphinus delphis ponticus subsp. n. Bull. Soc. Naturalistes Moscou, vol. 44 (n.s.) no. 5, pp. 346–349. 1935. (New: *Delphinus delphis ponticus*).

BARBOUR, ERWIN HINCKLEY, and GEORGE F. STERNBERG. Gnathabelodon thorpei, gen. et sp. nov. A new mud-grubbing mastodon. Nebraska State Mus., vol. 1, bull. 42, pp. 395–404, figs. 187–191. May, 1935. (New: *Gnathabelodon, G. thorpei*.)

BARCLAY, EDGAR N. The roe-deer of Korea. Ann. and Mag. Nat. Hist., London, ser. 10, vol. 15, no. 90, pp. 626–627. June, 1935. (New: *Capreolus capreolus ochracea*.)

——— The roe-deer of European Turkey. Ann. and Mag. Nat. Hist., London, ser. 10, vol. 17, no. 99, pp. 404–405. March, 1936. (New: *Capreolus capreolus whittalli*.)

[BARGER, A. KATHERINE] The record proboscidean tusk. Natural History, New York, vol. 35, no. 4, p. 357. April, 1935. (*Archidiskodon imperator;* length 15 ft. 4 in.)

BAXTER, JAMES S. On the female genital tract in the caenolestids (Marsupialia). Proc. Zool. Soc. London for 1935, pt. 1, pp. 157–162, figs. 3. April, 1935.

BENEDICT, FRANCIS G., and ERNEST G. RITZMAN. Lability of the basal metabolism of the dairy cow. Proc. Nat. Acad. Sci., Washington, vol. 21, no. 6, pp. 304–308. June, 1935.

BENHAM, W. B. The teeth of an extinct whale, Microcetus hectori n. sp. Trans. Roy. Soc. New Zealand, vol. 65, pp. 239–243, pls. 28–29. December, 1935. (New: *Microcetus hectori*.)

BIRD, E. G. Jan Mayen Island. A summer visit in 1934. Geogr. Journ., London, vol. 85, no. 6, pp. 553–557, pls. 2. June, 1935. (Cetacean skulls and bones strewn on beach are valueless because of their poor state of preservation. Impossible to obtain complete skeleton of *Balaena mysticetus*.)

BISSONNETTE, THOMAS HUME. Modification of mammalian sexual cycles. II. Effects upon young male ferrets (Putorius vulgaris) of constant eight and one-half hour days and of six hours of illumination after dark, between November and June. Biol. Bull., vol. 68, no. 2, pp. 300–313, pl. 1. April, 1935.

BLACK, DAVIDSON. Geology of fossil man in China. Pan-Amer. Geol., vol. 62, no. 4, pp. 267–272, fig. 1. November, 1934.

BLACKBURN, H. V. A bull gaur (*B. gaurus*) and a tigress fight to death. Journ. Bombay Nat. Hist. Soc., vol. 37, no. 4, p. 950. April 15, 1935.

BODE, HERMANN. Waschbärenzucht. Der Deutsche Pelztierzüchter, Munich, Jahrg. 9, no. 20, pp. 387–391, illus. October 15, 1934.

BÖKER, HANS. Die aüssere Nase als anatomische Konstruktion. Zeitschr. f. Morphol. u. Anthrop., Stuttgart, vol. 34 (Festbd. Eugen Fischer), pp. 47–53, figs. 5. 1934. (The form of the human nose is a by-product of the enlargement of the human brain and the regression of the facial part of the human skull.)

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nitrogen and favorable conditions of circulation appear to eliminate danger of caisson disease.)

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——— Desmostylus sp. des dépôts tertiaires de l'île de Sakhalin. Vestnik Geol. Komit. (Bull. Com. Géol., Leningrad, vol. 46), 1927, no. 3, pp. 21–24, pl. 1. 1927. (Tooth, probably Miocene age.)

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——— On the synonymy of the North Korean musk-shrew. Dobutsugaku Zasshi, Zool. Soc. Japan, Tokyo, vol. 47, p. 327. May 15, 1935. (New: *Crocidura sodyi* for *Crocidura neglecta* Kuroda, 1934, not Jentink, 1888. In Japanese.)

——— Phoca richardii pribilofensis obtained in the Robben Ids., Saghalien. Dobutsugaku Zasshi, Zool. Soc. Japan, Tokyo, vol. 47, pp. 353–354. June 15, 1935. (In Japanese.)

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LAWRENCE, BARBARA. New Geocapromys from the Bahamas. Occas. Papers Boston Soc. Nat. Hist., vol. 8, pp. 189–196. November 7, 1934. (New: *Geocapromys ingrahami irrectus*, *G. i. abaconis*.)

LAWRENCE, BARBARA, and SHERWOOD L. WASHBURN. A new eastern race of Galago demidovii. Occas. Papers Boston Soc. Nat. Hist., vol. 8, pp. 255–266. January 8, 1936. (New: *Galago demidovii orinus*.)

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LEMOINE, PAUL. Le Muséum National d'Histoire naturelle. Son histoire—son état actuel. Pt. 1. Historique Général. Archiv. Mus. Nat. d'Hist. Nat., Paris, ser. 6, vol. 12, pp. 3–79, figs. 18. June, 1935. (volume du Tricentenaire, vol. 1.)

LIEBUS, ADALBERT. Beiträge zur Kenntnis der Wirbeltierfauna des böhmischen Quartärs. Lotos, Prag, vol. 81, pp. 17–34, pls. 3. 1933.

LOEWEN, S. L. A new cestode from a bat. Trans. Kansas Acad. Sci., vol. 37, pp. 257–258, pl. 7. 1934. (*Oochoristica taborensis* from *Lasiurus borealis*.)

LOOMIS, FREDERIC B. Three new Miocene dogs and their phylogeny. Journ. Paleont., vol. 10, no. 1, pp. 44–52, figs. 6. January, 1936. (New: *Mammacyon*, *M. obtusidens*, *Daphaenodon niobrarensis*, and *Temnocyon typicus*.)

LUTTRINGER, LEO A., JR. The truth about the black bear. Nature Mag., vol. 25, no. 8, pp. 323–325, illus. June, 1935. (Nation wide census indicates that black bear will disappear unless rigidly protected.)

MALLNER, FELIX. Der Gestationswechsel bei Mardern und Zobeln. Der Deutsche Pelztierzüchter, Munich, Jahrg. 9, no. 8, pp. 145–150. April 15, 1934.

——— Der Gestationswechsel bei Mardern und Zobeln. Der Deutsche Pelztierzüchter, Munich, Jahrg. 9, no. 9, pp. 165–170, illus. May 1, 1934.

MARTINO, E., and V. MARTINO. Novi jez iz Vardarske banovine. Prirodoslovne

Razprave, vol. 2, no. 1, pp. 56–57. April 13, 1933. (New: *Erinaceus roumanicus roumanicus drozdovskii*. In Jugoslavian, with English summary.)

McDougall, E. G. Moose in Ontario. Rod and Gun in Canada, vol. 36, no. 11, p. 11, map. April, 1935.

Mendonça, Boúrguy de. O Megatherium do Museu Nacional (Notas extrahidas de trabalhos deixados pelo Professor Teixeira Mendes.). Bol. Mus. Nac., Rio de Janeiro, vol. 10, pp. 95–98, pls. 2. 1934.

Miller, Clyde. What becomes of a deer's shed horns? Outdoor Life, vol. 75, no. 6, pp. 22–23, 88, illus. June, 1935.

Mohr, Charles E. Preliminary report on the mammals of Pennsylvania. Proc. Pennsylvania Acad. Sci., Harrisburg, vol. 5, pp. 17–27. 1931.

——— Marking bats for later recognition. Proc. Pennsylvania Acad. Sci., Harrisburg, vol. 8, pp. 26–30, fig. 1. 1934. (Records the finding of 77 individuals of *Myotis subulatus leibii* in central Pennsylvania.)

Mohr, Erna. Das Waldross der Insel Gotland. Zool. Garten, n.F., vol. 6, nos. 4–6, pp. 83–96, figs. 13. July, 1933.

Morales Agacino, E. Sobre algunos insectivoros de Saint Joseph de Luluabourg (Congo Belga). Bol. Soc. Española Hist. Nat., Madrid, vol. 35, pp. 17–23, fig. 1. 1935. (New: *Crocidura zena cabrerai*.)

——— Mamíferos de Ifni. Bol. Soc. Española Hist. Nat., Madrid, vol. 35, pp. 381–393. fig. 1. 1935. (New: *Lemniscomys barbarus ifniensis*.)

Murie, O. J. Studies in elk management. Trans. 20th Amer. Game Conference, 1934, Amer. Game Assoc., New York, pp. 355–359. 1934.

——— Alaska-Yukon caribou. North Amer. Fauna no. 54, pp. 93, figs. 15, pls. 10. June, 1935.

Murr, Erich. Die Fortpflanzung des Frettchens (*Putorius furo* L.). Eine Zusammenfassung unserer Kenntnisse auf Grund eigener und fremder Untersuchungen, zugleich eine Einführung in die Fortpflanzungskunde der Säugetiere. Zeitschr. f. Züchtung, Reihe B, Tierzüchtung u. Züchtungsbiologie einschliesslich Tierernährung, Berlin, vol. 32, no. 3, pp. 385–408, figs. 29. June, 1935.

Nagao, Takumi. Desmostylus mirabilis nov. from Saghalin. Journ. Geol. Soc. Japan, vol. 42, nos. 504–507, pp. 822–824. [Trans. Proc. Paleont. Soc. Japan, 1935, no. 1.] (New: *Desmostylus mirabilis*. In Japanese, with short English summary.)

Neuville, Henri. De l'organe femelle de l'hyène tachetée (*Hyaena crocuta* Erxl.). Archiv. Mus. Nat. d'Hist. Nat., Paris, ser. 6, vol. 12, pp. 225–229, figs. 2. June, 1935. (volume du Tricentenaire, vol. 1.)

Ognev, S. I. The mammals of USSR and adjacent countries. (The mammals of eastern Europe and northern Asia.), Moscou and Leningrad, vol. 3, pp. 752, figs. 299, maps 19, pls. 8. 1935. (Carnivora, Fissipedia and Pinnipedia. New: *Mustela erminea shnitnikovi, Vulpes corsak kalymkorum, Vulpes corsak turkmenicus*.)

——— A systematical review of the squirrels found in USSR. Abstracts works Zool. Inst. Moscou State Univ., No. 2, pp. 42–51. 1935. (New: *Sciurus vulgaris fedjushini, S. v. formosovi, S. v. bashkiricus, S. v. bashkiricus uralensis, S. v. jenissejensis*.)

Oliver, J. Allemaal zwijnerij. Tropische Natuur, Buitenzorg, vol. 22, no. 10, pp. 184–188, fig. 1. October, 1933. (Notes on tusks of *Sus vittatus* and *S. verrucosus* in Java.)

Orlov, J. A. Über die Reste der fossilen Camelidae aus dem Gouvernement Semipalatinsk (Westsibirien). Ann. Soc. Paléont. Russie, Leningrad, vol. 8, pp. 99–116, pls. 12–14. 1930. (New: *Paracamelus sibiricus*.)

PAVLOVA, M. V. Der Familie der Titanotherien, des Tertiärs in Nord-Amerika, Asien und Europa. Zoologicheskii Zhurnal (Zool. Jour. USSR), Moscou, vol. 13, no. 2, pp. 398–403. 1934. (In Russian.)

PERCY-SMITH, E. The quest of the bongo: A rare antelope taken alive. Illus. London News, vol. 181, no. 4871, pp. 293–295, illus. August 27, 1932.

PERCY-SMITH, ERIC, and MRS. W. MITTON. The first living male bongo kept in a European "Zoo." The story of his capture in the mountain forests of Kenya: With an Englishwoman's account of his attack on her, before his removal to Rome. Illus. London News, vol. 184, no. 4945, pp. 121–123, illus. January 27, 1934. (Full grown bongos range from 400 to 600 lbs., in weight.)

PETER, KARL. Über Haltung und Zucht des Zwerggalagos (*Galago zanzibaricus* Mtsch.). Zool. Garden, n. F., vol. 6, nos. 7–9, pp. 165–173, figs. 11. October, 1933.

PHILLIPS, W. W. A. The short-nosed fruit bats (*Cynopterus*) of Ceylon. Ceylon Journ. Sci., Sec. B. Zool. and Geol., Spolia Zeylanica, Colombo, vol. 18, pt. 2, pp. 237–248. May 22, 1934.

PIETERS, D. Ondervindingen en waarnemingen omtrent olifanten in Sumatra. 1. Het woongebied der olifanten. 2. Voedsel en dagverdeeling der olifanten. Tropische Natuur, Buitenzorg, vol. 21, no. 4, pp. 57–59, fig. 1, April, 1932; no. 9, pp. 158–162, fig. 1, September 1932. (Notes on elephants in Sumatra. Habitat, food, and daily routine. 2000 estimated as occurring in south Sumatra.)

POCOCK, R. I. The Javan race of the oriental yellow-throated marten, Lamprogale flavigula. Ann. and Mag. Nat. Hist., ser. 10, vol. 17, no. 99, pp. 403–404. March, 1936. (New: *Lamprogale flavigula robinsoni*.)

——— The races of Canis lupus. Proc. Zool. Soc. London for 1935, pt. 3, pp. 647–686, pls. 2. September 12, 1935. (New: *Canis lupus rex, C. l. arctos, C. l. orion*.)

RAO, C. R. NARAYAN. On a new fossil hyaena. Half-Yearly Journ. Mysore Univ., vol. 6, no. 1, pp. 99–103, figs. 5. 1932. (New: *Crocuta pilgrimina*.)

REYNOLDS, T. EMMETT. Two new insectivores from the lower Paleocene of New Mexico. Journ. Paleontology, vol. 10, no. 3, pp. 202–209, figs. 2, pl. 25. April, 1936. (New: *Puercolestes, P. simpsoni, Escatepos, E. campi*.)

ROBERTS, AUSTIN. Report upon a survey of the higher vertebrates of north-eastern Zululand. Mammals collected in Zululand, in 1928, 1929 and 1933. Ann. Transvaal Mus., vol. 18, pt. 3, pp. 222–251. 1936. [see also, pp. 170–173] (New: *Aethomys chrysophilus tongensis, Tatera maputa, Hystrix africae-australis zuluensis, Pronolagus ruddi lebombo, Cephalophus natalensis lebombo*.)

——— New South African mammals. Ann. Transvaal Mus., vol. 18, pt. 3, pp. 253–254. 1936. (New: *Chlorotalpa guillarmodi, Myonax pulverulentus basuticus, Dasymys incomtus capensis*.)

ROMAN, F., and J. VIRET. Le Miocène continental de l'Armagnac et le gisement burdigalien de La Romieu (Gers). Liv. Jub. 1830–1930, Centenaire Soc. géol. France, Paris, vol. 2, pp. 577–604, figs. 9. 1930. (New: *Lagopsis cadeoti, Prolagus vasconiensis, Cricetodon infra-lactorensis, C. quadratum*.)

RUMMLER, HANS. Neue Muriden aus Neuguinea. Zeitschr. f. Säugetierkunde, vol. 10, no. 1, pp. 105–118. December 31, 1935. (New: *Macruromys major, Melomys rufescens dollmani, Melomys lutillus hintoni, Melomys levipes arfakianus, M. l. weylandi, M. l. clarae, M. l. meeki, M. l. stevensi, M. l. shawmayeri, Melomys moncktoni fuscus, M. m. intermedius, M. m. arfakiensis, M. m. steini, M. m. rutilus, M. m. alleni, M. m. clarus, M. m. stresemanni, M. m. pohlei, M. m. jobiensis, Rattus leucopus utakwa, R. l. steini, R. l. jobiensis, Stenomys verecundus mollis, S. v. försteri, S. v. unicolor, Stenomys niobe stevensi, S. n. arfakiensis, S. n. clarae*.)

SCHULTZ, C. BERTRAND, and EDGAR B. HOWARD. The fauna of Burnet Cave, Guadalupe Mountains, New Mexico. Proc. Acad. Nat. Sci. Philadelphia, vol. 87, pp. 273–298, pls. 11–16. October 4, 1935. (New: *Rangifer? fricki*, *Euceratherium collinum morrisi*, *Preptoceras sinclairi neomexicana*.)

SODY, H. J. V. Seventeen new generic, specific, and subspecific names for Dutch East Indian mammals. Natuurkundig Tijdschrift voor Nederlandsch-Indië, Batavia, vol. 96, no. 1, pp. 42–55. 1936. (New: *Macaca nemestrina nucifera*, *Arctictis binturong kerkhoveni*, *Prionodon linsang fredericae*, *Herpestes javanicus orientalis*, *Prionailurus viverrinus rhizophoreus*, *Megaderma spasma pangadarana*, *Hipposideros larvatus neglectus*, *H. celebensis*, *Scotophilus temmincki collinus*, *Scotophilus castaneus solutatus*, *Choerephon plicatus adustus*, *Acerodon mackloti prajae*, *Crocidura brunnea pudjonica*, *Crocidura orientalis lawuana*, *Crocidura maxi*, *Tana tana nainggolani*, *Mazomys* for *Mus bartelsii* Jentink.)

ST. LEGER, J. A new race of Poëlagus from the Bahr-el-Ghazal. Ann. and Mag. Nat. Hist., London, ser. 10, vol. 16, no. 96, pp. 598–600. December, 1935. (New: *Poëlagus marjorita larkeni*.)

STOCK, CHESTER. Sespe Eocene didelphids. Proc. Nat. Acad. Sci., vol. 22, no. 2, pp. 122–124, pl. 1. February, 1936. (New: *Peratherium californicum*.)

——— Hesperomeryx, a new artiodactyl from the Sespe Eocene, California. Proc. Nat. Acad. Sci., vol. 22, no. 3, pp. 177–182, pl. 1. March, 1936. (New: *Hesperomeryx*, *Leptoreodon* (*Hesperomeryx*) *edwardsi*.)

TATE, G. H. H., and RICHARD ARCHBOLD. Results of the Archbold expeditions No. 8. Four apparently new polyprotodont marsupials from New Guinea. Amer. Mus. Novitates no. 823, pp. 4. March 9, 1936. (New: *Echymipera oriomo*, *Phascogale rona*, *Phascogale tafa*, *Phascogale* (*Phascolosorex*) *dorsalis whartoni*.)

——— Results of the Archbold expeditions. No. 9. A new race of Hyosciurus. Amer. Mus. Novitates no. 846, p. 1. April 29, 1936. (New: *Hyosciurus heinrichi ileile*.)

TIMOFEEV, V. K. Materialien zur Biologie und Oekologie der Säugetiere auf der Insel Barasa-Kelmes im Aralsee im Zusammenhang mit der Akklimatisation der gelben Ziesselmaus (*Citellus fulvus* Licht.) auf dieser Insel. Zoologicheskii Zhurnal (Zool. Journ. USSR), Moscou, vol. 13, no. 4, pp. 731–758, figs. 7, map. 1934. (New: *Hemilchinus* [sic] *albulus insularis*. In Russian, with German summary.)

TOEPFER, VOLKER. Ein diluviales Steinbockgehörn aus Thüringen. Palaeont. Zeitschr., vol. 16, nos. 3–4, pp. 276–281, 1 pl. December 31, 1934. (New: *Capra camburgensis*.)

TROUGHTON, E. LE G. The southern race of the koala. Australian Nat., Sydney, vol. 9, pt. 6, pp. 137–140. September, 1935. (New: *Phascolarctos cinereus victor*.)

WILSON, LESLIE E. Miocene marine mammals from the Bakersfield region, California. Peabody Mus. Nat. Hist., bull. no. 4, pp. 143, figs. 23. September 9, 1935. (New: *Allodelphis*, *A. pratti*, *Macrodelphinus*, *M. kelloggi*, *Acrodelphis bakersfieldensis*, *Miodelphis*, *M. californicus*, *Doliodelphis*, *D. littlei*, *Eurhinodelphis extensus*.)

WOOD, ALBERT ELMER. A new subfamily of heteromyid rodents from the Miocene of the western United States. Amer. Journ. Sci., ser. 5, vol. 31, no. 181, pp. 41–49, figs. 7. January 1, 1936. (New: *Florentiamyinae*, *Florentiamys*, *F. loomisi*, *F. lulli*.)

——— The cricetid rodents described by Leidy and Cope from the Tertiary of North America. Amer. Mus. Novitates no. 822, pp. 8, figs. 5. March 9, 1936. (New: *Leidymys*, for *Hesperomys nematodon* Cope, *Copemys*, for *Eumys loxodon* Cope.)

OBITUARY NOTICES

WILLIAM LOUIS ABBOTT

William L. Abbott, one of the charter members of the American Society of Mammalogists, and a life member since 1926, died in Philadelphia on April 2, 1936. He was born in the same city, February 23, 1860. His sister, Miss Gertrude Abbott, has kindly given the following account of her brother's education.

Abbott went to the Episcopal Academy in Philadelphia and afterward to the University of Pennsylvania, graduating in 1881 and obtaining his M.A. He studied medicine at the same university in the class of 1884. After nine or ten months as interne at the General Hospital he went to England and took the degrees of L.R.C.P. and L.R.C.S. in 1886, then working for a time in Guy's Hospital, London. After this time he never practiced medicine or surgery, except occasionally in the care of his porters or coolies; but his medical studies laid a splendid foundation for his work as a naturalist.

Abbott's first important field trip took him in 1883 to the Samaná Bay region of the Dominican Republic. Just 40 years later his active work ended there with the rediscovery of living *Plagiodontia*, a genus of large rodents no member of which had been seen alive by a naturalist since Ricord discovered the type species in 1826.

The years between 1888 and 1923 were filled with ceaseless exploration in the interests of the Smithsonian Institution, of which Abbott must always rank among the most generous and disinterested benefactors. Madagascar, the Seychelle Islands, East Africa, Kashmir, and eastern Turkestan were visited or revisited at different times during the period extending from 1888 to 1895. In 1896 Abbott began his most important work, the exploration of the Malayan Peninsula and Archipelago. This undertaking, interrupted by a few returns to his beloved Kashmir, occupied him until failing health forced him to abandon it in December, 1915.

The collections thus brought together are of inestimable worth in the fields that they cover. Although they include plants, land shells, ethnological material (especially basketry, wood carving and metal work), and vertebrates of all classes, they are particularly rich in mammals and birds, the groups that appealed most strongly to Dr. Abbott's interest. The mammals number about 10,000. Among them there are the type specimens of 462 forms described as new.

BENJAMIN ARTHUR BENSLEY

Benjamin Arthur Bensley, head of the Department of Biology, University of Toronto, and Director of the Royal Ontario Museum of Zoology, died at his home in Toronto on January 20, 1934. Dr. Bensley was born in Hamilton on November 5, 1875, the youngest son of Robert Daniel Bensley and Caroline Vandeleur Bensley. He graduated from the University of Toronto in 1896, and took his Doctor's degree at Columbia University in 1902.

Bensley's contribution to the Royal Ontario Museum, like his work at the University, is much greater than might be supposed. His nature inhibited a general recognition that he was a leader in a public institution, but his conservative, sound judgment has played its part in fixing the type of the institution as a whole. He superintended the rapid growth of his own department, the Royal Ontario Museum of Zoology, with sincere interest and safe policies, and permitted his younger colleagues to exercise their initiative in expanding the department's activities and influence.

His field of research was the comparative anatomy of vertebrates, and our knowledge of mammalian anatomy was especially enriched by his work. His great memoir on the Marsupialia probably is his best known contribution and, although this was published

more than 30 years ago, it still is regarded not only as an authoritative work on the subject, but as a notable example of scientific ratiocination. A number of additional papers dealing with problems on the origin of the marsupials, and with the interrelationships of the mammalian subclasses, were published during the same period of his life. Subsequently several of his papers dealing with palaeontological subjects, mostly on mammals, appeared in the University of Toronto Studies, Biological Series.

Bensley's "Practical Anatomy of the Rabbit" is the standard text on this subject at the University of Toronto and elsewhere. It is a model of exactness for text books. At the time of his death he had all but completed a comprehensive work on comparative dental anatomy.—L. L. SNYDER.

CHARLES VELMAR GREEN

Charles Velmar Green, a Director and Research Associate of the Roscoe B. Jackson Memorial Laboratory, was drowned accidentally while fishing near Bar Harbor, Maine, on April 18th, 1936. This was a tragic termination of a character marked by outstanding ability and industry.

From his boyhood Green had patiently and intelligently worked his way through school and Michigan State College. At the conclusion of his undergraduate career he took up work in genetics under the direction of Dr. Harrison Hunt, head of the Department of Zoology at Michigan State College. After he had obtained his Master's degree, he attended the University of Michigan, where, in 1930, he received the degree of Ph.D. While at the University of Michigan, and after that time, he was associated with the group now working at the Jackson Memorial Laboratory.

Doctor Green was a quiet and energetic worker, who, even at the age of thirty-four, had published more than 30 scientific papers dealing with mammalian genetics. He worked especially with crosses between the Chinese *Mus bactrianus* and derivatives of the ordinary house mouse. He had definitely established the linkage of certain genes of coat color with some of those that determine ordinary growth. He had contributed also to our knowledge of the process of differential growth and variations in linkage correlated with age.

Because of his modesty and ability, Green exerted a great influence on those associated with him, and has left for them the inspiration and example of an honest and industrious character and of a gentle and considerate personality. His loss is deeply felt.—C. C. LITTLE.

HARRY EDWARD WILDER

Harry Edward Wilder was born in Peterborough, New Hampshire, on September 19, 1864. His father was the owner of the Wilder thermometer factory. The death of his mother when he had just finished high school made it necessary for him to spend much of his time in caring for the home and his younger sisters. He always was deeply interested in nature, and in taxidermy. Occasionally he visited the establishment of Frank Blake Webster in Boston, and it was not long before he became an expert in mounting birds and mammals. Even in his later years he mounted many game heads for local sportsmen each year.

In 1887–1888 he travelled in Oregon and Washington, selling books for a Chicago firm. The following year he moved to San Bernardino, California, and became interested in bee keeping. In 1892 he took up a government claim in the Jurupa Hills, Riverside County, and established an apiary there. At this time he was active in collecting specimens of birds and mammals for study and exchange.

On January 1, 1898, he married Charlotte M. Thurber, who also was interested in wild life and botany. For the next 14 years many field trips were made, to desert and

mountain, and once to Siskiyou County, as the intermittent work in the apiary permitted. Within this period, in 1906, an expedition was made with Samuel N. Rhoads down the peninsula of Lower California.

In 1912 the bee ranch was sold and the Wilders moved to Carlotta, Humboldt County, where, at the edge of the redwoods overlooking the Eel River Valley, a home was built. Here Harry Wilder spent the remaining years of his life, fishing, hunting, collecting, and leading an existence of a sort and amid surroundings that was well-nigh ideal. Here came a long list of naturalists to a spot that to many of them has become enshrined in their hearts because of the beauty of the surroundings and of the character of the people who lived there.

It is one's privilege to know few men that measure up to Harry Wilder. He was a kindly, courteous gentleman, whose utter contentment and philosophy of life were an inspiration to those privileged to know him well. I shall not know his like again.

The immediate cause of his passing, on April 9, 1935, was a third stroke of paralysis. His last three days were spent in unconsciousness, and during this time his devoted Airedale, Jeff, refused to leave his bed in the workshop, and died the day after his master had passed.—A. B. H.

COMMENT AND NEWS

It is a satisfaction to be able to report that The Whaling Treaty Act (S. 3413), having passed both houses of The Congress, was approved by the President on May 1, 1936. On this matter the Society's Committee on Marine Mammals and the affiliated Council for the Conservation of Whales have been working for about seven years. The long delay in accomplishment has been attributable to the invariable difficulty in obtaining international regulation regarding anything involving the freedom of the seas. Often for months on end nothing could be done. There was no course possible other than waiting. The final passage of the law affecting the United States can be credited to the unflagging interest and zeal of Senator Peter Norbeck and T. S. Palmer.

The Whaling Treaty Act provides for everything that the Society reasonably could desire at this time, chiefly the total protection of all right whales and the California gray whale, the protection of calves and of cows with calves, prohibition of the killing of whales for sport, and the licensing of companies engaged in whaling.